

THE MINERAL INDUSTRY OF BRAZIL

By Alfredo C. Gurmendi

In 2003, Brazil remained among the leading world producers of such mineral commodities as bauxite (after Australia and Guinea), columbium (niobium) (followed by Canada), iron ore (after China), graphite (after China and India), manganese (after Australia, Gabon, and South Africa); tantalum (after Australia), and tin (after China, Indonesia, and Peru) (Carlin, 2004; Corathers, 2004; Cunningham, 2004a, b; Kirk, 2004; Olson, 2004b; Plunkert, 2004).

In 2003, Brazil, which was an industrial power with the largest total area (more than 8.5 square kilometers) and population (184 million inhabitants) in Latin America, was the leading economy in the Mercado Común del Cono Sur (MERCOSUR), second in the Americas, and eighth worldwide. It had a gross domestic product (GDP) of \$1.38 trillion¹ in terms of purchasing power parity. Brazil's GDP growth rate was -0.2% compared with 1.5% in 2002. Foreign exchange reserves increased to about \$37.8 billion from \$35.9 billion in 2002 and the peak level of \$51.4 billion in 1997. Brazil's total debt burden increased slightly to \$223.6 billion from \$222.4 billion in 2002. The trade balance increased substantially to a new peak level of \$25.0 billion surplus compared with \$13.2 billion in 2002 and \$2.7 billion in 2001. Exports were valued at \$73.3 billion, and imports, \$48.3 billion compared with \$60.4 billion and \$47.2 billion, respectively, in 2002. The growth of Brazil's economy slowed in 2003 as the country absorbed a series of domestic and international economic shocks without financial collapse owing to floating exchange rates, increasing of interest rates by the Banco Central do Brasil to fight inflationary pressures, and tight fiscal policy, which had been reinforced by a series of International Monetary Fund economic programs. Inflation was 9.3% compared with 8.3% in 2002 and 7.7% in 2001. The devaluation of Brazil's Real helped moderate the downturn in economic growth from 2001 through 2003 when the country's economy grew, on average, by only 1.1% per year (Confederação Nacional do Comércio, 2004, p. 3; Departamento Nacional de Produção Mineral, 2004a, p. 9-10; Banco Central do Brasil, 2004§;² U.S. Central Intelligence Agency, 2004§; U.S. Department of State, 2004§).

In 2003, South America's foreign direct investment (FDI) inflows decreased in spite of increases in the emerging economies to \$162 billion from \$102 billion in 2002. Of this total, Asia received \$84.2 billion, or 52%; Latin America, \$36.5 billion, or 22.5%; and others, \$41.3 billion, or 25.5%. In a continuation of the downward trend that had begun in 2001, the FDI inflows into South America decreased to \$21.5 billion in 2003 from \$26.5 billion in 2002 and \$38.5 billion in 2001. In the Andean community, inflows were more stable, but the steepest decrease was in MERCOSUR, particularly in Brazil, which decreased to \$11.4 billion in 2003 from \$17.5 billion in 2002 and \$25.0 billion in 2001. Brazil's share of the region's FDI inflows decreased to \$10.1 billion in 2003 from \$16.6 billion in 2002 and \$22.5 billion in 2001. This reduction was strongly impacted by Brazil's sluggish economic activity and Argentina's worsening economic crisis, which made MERCOSUR less attractive to foreign investment (Banco Central do Brasil, 2004§; Economic Commission for Latin America and the Caribbean, 2004§).

The International Monetary Fund endorsed Brazil's move to a system of inflation targets and currency devaluation to guide its monetary policy during 2002-03. This action indicated that the country could reduce its account deficit to \$26.2 billion from \$35.2 billion in 2002, which would be equivalent to 5.8% of the GDP, thus helping restore confidence in the Government's economic management and creating conditions for lower interest rates and economic recovery (Banco Central do Brasil, 2004§).

The Brazilian strategic plan (Plano Real) continued to be based on constitutional reviews, joint ventures with the private sector in the hydrocarbons industry, and macroeconomics to achieve its goals and to encourage additional capital flows into the country's economy. Given that the economy was in recovery, however, the currency devaluation and a tough fiscal austerity plan helped restore confidence in the Government's economic management and create favorable conditions for lower inflation and interest rates and Brazil's economic recovery in the foreseeable future (Departamento Nacional de Produção Mineral, 2004a, p. 11, 16; Banco Central do Brasil, 2004§).

In 2003, Brazil's exports of goods improved substantially, and its trade balance was \$24.8 billion compared with \$13.1 billion in 2002. The mineral sector had a surplus of \$2.8 billion compared with a deficit of \$681 million in 2002; if coal, natural gas, and petroleum and its derivatives were excluded, however, then the surplus would have been \$7.9 billion (Departamento Nacional de Produção Mineral, 2004a, p. 16-17).

Brazil produced 72 mineral commodities (46 industrial minerals, 22 metals, and 4 fuel minerals), such as bauxite, coal, columbium (niobium), chromite, gemstones, gold, iron ore, kaolin, manganese, tantalum, and tin from large deposits and exported them to the global marketplace in 2003. In Latin America, and particularly within MERCOSUR, Brazil continued to be the leading producer of aluminum, cement, ferroalloys, gold, iron ore, manganese, steel, and tin. Brazil's reportedly large mineral reserves and other identified resources help make it one of the most dynamic markets in the world and one-third of the Latin American economy (Departamento Nacional de Produção Mineral, 2004a, p. 11-12). The country continued with its petroleum exploration program to expand reserves and to reduce dependence on oil imports, which satisfied almost 22% of its crude oil requirements (Departamento Nacional de Produção Mineral, 2004d, p. 103; Petróleo Brasileiro S.A., 2004, p. 4).

Brazil's petroleum and mining industries and utilities attracted investor interest because of the country's diversified mineral endowment, the Government's macroeconomic policies, and a skilled labor force. Major international mining, petroleum, and steel companies were notably interested in, in order of importance, oil and gas, iron ore, steel, coal, gold, copper, and diamond.

¹ Where necessary, values have been converted from Brazilian real (R\$) to U.S. dollars (US\$) at the rate of R\$3.08=US\$1.00.

² References that include a section mark (§) are found in the Internet References Cited section.

BP Amoco p.l.c., Exxon Mobil Corp., ChevronTexaco Corp., and others entered into joint-venture oil-gas projects with Petróleo Brasileiro S.A. (Petrobrás). In 2003, Petrobrás continued to view these joint ventures as significant to the improvement and strengthening of the economies of scale, competitiveness, and operational synergy, which will affect future oil-gas joint ventures between Petrobrás and the private sector. Equally important to Brazil were the Minas Gerais iron ore joint venture between Companhia Vale do Rio Doce (CVRD) and China's Shanghai Baosteel Group Corp. and the Sossego copper-gold joint venture between CVRD and Phelps Dodge Corp. of the United States (Ferraz, 2004, p. 1-2; Latin Trade, 2004). Since 1991, the more-than 500 transnational corporations that have established operations in Brazil have brought in about \$250 billion in registered investment with the Banco Central do Brasil; of that total, about \$60 billion was received by the minerals sector. The Banco Central do Brasil (2004§) also reported that since 1996, the accumulated net FDI amounted to more than \$151 billion as equity capital, of which \$35 billion was used for acquisitions of state-owned assets and more than \$116 billion (excluding privatizations), for direct investment and joint ventures with the private sector.

Active international mining and oil companies in Brazil included Yacimientos Petroleros Fiscales (YPF) de Argentina; BHP Minerals International Exploration Inc. and Western Mining Corp. Holdings Ltd. of Australia; Barrick Gold Corp., INCO Limited, and TVX Gold Inc. of Canada; Shanghai Baosteel of China; EDP of Portugal; Anglo American plc, BHP Billiton Plc, and Rio Tinto plc of the United Kingdom; Iberdrola S.A. of Spain; and ChevronTexaco (ChevronTexaco Brasil S.A.), Dow Chemical Co., ExxonMobil (Esso Brasileira de Petróleo Ltda.), Newmont Mining Corp., and Placer Dome U.S. Inc. of the United States; and Royal Dutch/Shell Group of the Netherlands (Departamento Nacional de Produção Mineral, 2004d, p. 103).

Government Policies and Programs

The legal framework for the development and use of mineral resources in Brazil was established by the Federal Constitution, which was enacted on October 5, 1988. On August 15, 1995, the Brazilian Congress approved Constitutional Amendments Nos. 6 and 9, which allow the participation of the private sector by means of joint ventures and/or privatization investment in the sectors of mining, natural gas, and petroleum and in the deregulated sectors of coastal and river shipping, telecommunications, and transportation. The Government monopolies of the oil and gas industries and fuel price subsidies that had been in effect for 45 years were rescinded in 1999, which allowed Petrobrás to enter into joint ventures with foreign investors. The Agência Nacional do Petróleo regulates the petroleum industry (Ferraz, 2004, p. 9; Pimentel, 2004a, p. 3 5; Departamento Nacional de Produção Mineral, 2004§). Since 2001, the Government reduced the Brazilian import tax rates for minerals, which vary from 3% to 9%—ores and concentrates are 5%, and other mineral products, 7%. The export tax does not apply to exported mineral products. The tax on industrialized products does not apply to mining activities, although there is a value-added tax. In most cases, the basis for the assessment of corporate income taxes is the net profit for the fiscal year; the tax rate ranges between 10% and 15% and is levied on gross profit. Profits can be expatriated. Equity ownership, which is allowed by means of privatization or by direct acquisition, can be as high as 100% (Pimentel, 2004b, p. 10-15; Departamento Nacional de Produção Mineral, 2004c, p. 5-8; 2004§). In 2001, the Concessions Law created additional opportunities for the private sector in public utilities previously reserved for the Government.

All the above actions, which were undertaken by the Government to open the Brazilian economy to international competition, have continued to create an environment that attracts domestic and foreign investments equally. The establishment of joint ventures in the sectors of, in order of importance, mining, oil and gas, construction and management of railroads, ports, telecommunications, and hydroelectric powerplants has become a common practice in Brazil.

The exploration and exploitation of mineral resources in Brazil are defined and regulated by the 1967 Mining Code (Executive law No. 227 of February 28, 1967). The Brazilian Constitution and the Mining Code, law No. 9314 of January 1997, provide greater flexibility for investment in the Brazilian mining sector. Article 7 of this law stipulates that the exploitation of mineral deposits will depend upon an Exploration Authorization Permit granted by the General Director of the Departamento Nacional de Produção Mineral (DNPM) and a Development Concession issued by the Ministro do Minas e Energia. Licensing is a restricted system applicable exclusively to the exploitation of industrial minerals. The DNPM is responsible for enforcing this mining code and its complementary legal provisions. In 2003, the DNPM issued almost 9,000 exploration licenses compared with 9,309 in 2002 and 11,225 in 2001 and reported an investment of \$200 million in mineral exploration compared with \$195 million in 2002 and \$180 million in 2001. Companhia de Pesquisa de Recursos Minerais (CPRM) (the Brazilian Geological Survey) is developing programs for basic geologic mapping, metallogenetic and hydrogeologic mapping, and prospecting in areas of potential development, in addition to creating and maintaining geologic and economic data bases, particularly for coal, copper, diamond, gold, kaolin, nickel, peat, and zinc, to assist potential investors in the minerals sector (Departamento Nacional de Produção Mineral, 2004§).

In Brazil, Compensação Financeira pela Exploração de Recursos Minerais (CFEM), which is a program that provides financial compensation [permitting proceeds] to companies that explore for mineral resources, was established by the Brazilian Constitution of 1988 and instituted by law No. 7,990 in 1989. The municipal, State, and Federal Governments' direct administrative departments share CFEM in the proportions of 65%, 23%, and 12%, respectively. In July 2000, the Federal Government decided to share its CFEM income (law No. 9,993/2000) with the Fondo Nacional de Desarrollo Científico y Tecnológico (FNDCT), which is an instrument for technological innovation for the benefit of all Brazil's productive sectors. The FNDCT will receive a 3% share of all permitting proceeds. From 1997 through 2002, the CFEM collection was very successful and grew at the rate of 20% per year. In the first year (2001), the collection totaled \$161 million, or 15.7% higher than the expected \$144 million; in the second year (2002), \$186.2 million; in the third year (2003), \$223.4 million; and in the fourth year (2004), it is expected to be \$300 million (Departamento Nacional de Produção Mineral, 2004a, p. 27-28).

In 2003, the States of Minas Gerais (43%) and Para (27%) were the major collectors of CFEM; the main municipalities were Parauapebas (17%) and Oriximina (7%) in the State of Para and Itabira (14%) and Nova Lima (5%) in the State of Minas Gerais. Both States and their respective municipalities were the main producers of iron ore (46%), aluminum (9%), and gold, kaolin, and manganese (4% each) (Departamento Nacional de Produção Mineral, 2004a, p. 29-30).

Environmental Issues

In Brazil, the environmental issues related to the mining activity are governed by the following:

- Federal law No. 6938 of August 31, 1981, and its amendments (Acts Nos. 7804 of July 18, 1989, and 8028 of April 12, 1990) provide the purpose and mechanism for the formulation of the National Environmental Policy,
- Federal law No. 9605 of February 12, 1998, provides sanctions against harmful activities to the environment,
- Federal Decree No. 97632 of April 10, 1989, deals with rehabilitation of areas degraded by mining, and
- Federal Decree No. 99274 of June 6, 1990, regulates law No. 6938.

The Brazilian Environmental Policy (BEP) is executed at three levels—Federal, State, and municipal. The coordination and formulation of the BEP is the responsibility of the Ministério de Meio Ambiente (MMA). Linked to the MMA is the Conselho Nacional de Meio Ambiente, which grants the environmental licenses that are required for all mining activities in Brazil. Law No. 88351 of 1986 established the National System for the Environment, which comprises representatives of the Federal, State, and local governments and private foundations involved in environmental protection and improvement. Article 225 of the 1988 Brazilian Constitution stipulates that mining operators must reclaim areas that they have environmentally degraded.

In Brazil, the environmental legislation that is applied to mining is basically consolidated in the following environmental requirements: an environmental impact study (EIA), environmental licensing (LA), and a plan for recovery of degraded areas (PRAD). An EIA applies to mining projects of any mineral substance; an LA is mandatory for the installation, expansion, and operation of any mining activity under the systems of mining concession or licensing; and a PRAD requires suitable technical solutions to rehabilitate the soil and other aspects of the environment that might be degraded by mining operations (Departamento Nacional de Produção Mineral, 2004b, p. 35-38; 2004§). The Ministério de Minas e Energia enforces the 1989 decree, which prohibits the use of cyanide and mercury in the mining of gold unless approved by local Brazilian environmental agencies and offers technical assistance on producing gold without affecting the environment to small-scale independent miners (garimpeiros) in particular. Environmental impacts are expected to be reduced in the long run.

Resolution 010 of December 6, 1990, requires that all mining operations obtain LAs prior to the granting of mineral rights by the DNPM. As environmental problems have increased because of cyanide and mercury use in gold placers, in situ leaching, and underground acidic water discharges, antipollution measures have been enacted to eliminate the sources of pollutants and mitigate their effects on the environment.

Production

In 2003, the total value of minerals produced (gas and crude oil included) was almost \$13 billion, or about 2.8%, of the GDP. The minerals-based industries amounted to \$38 billion, or about 8.4%, of the GDP. Crude oil and natural gas amounted to almost \$6 billion. Mineral production contributed 10.4% of the GDP in 2003 compared with 3.2% in 2002. Depletion of shallow gold and tin deposits and environmental constraints on garimpeiros affected their output of gold and tin (Departamento Nacional de Produção Mineral, 2004a, p. 11; Banco Central do Brasil, 2004§).

The major integrated steelworks were the structure and rail producer Aço Minas Gerais, S.A., Latin America's leading integrated steelmaker Companhia Siderúrgica Nacional (CSN), the carbon steel sheet and plate producer Companhia Siderúrgica Paulista, the slab producer Companhia Siderúrgica de Tubarão, and Brazil's second leading steel mill Usinas Siderúrgicas de Minas Gerais, S.A. These companies produced about 18.5 million metric tons (Mt), or about 59%, of the total Brazilian steel production of 31.1 Mt. Brazil was the second leading iron ore producer in the world with a flat (gross weight) output of 215 Mt after China (Kirk, 2004). CVRD produced about 74.5% of the iron ore. Mineração Rio do Norte S.A. (MRN), the majority of which was privately owned, was the world's third leading bauxite producer and exporter; it produced about 75.2% of the country's total bauxite production, which amounted to about 18.5 Mt in 2003. The four major aluminum smelters, Albras-Alumínio Brasileiro S.A. (Albras) (29.8%), Companhia Brasileira de Alumínio (CBA) (23.7%), Alcoa Alumínio S.A. (Alcoa) (20.3%), and Billiton Metais S.A. (Billiton) (12.1%), produced 85.9% of the primary aluminum production of 1.38 Mt in 2003 (table 1; Departamento Nacional de Produção Mineral, 2004d, p. 36, 70-72).

Trade

Brazil was the leading open market in the economic center of MERCOSUR. In 2003, the member countries of MERCOSUR had almost 247 million people, or 27.1% of the Western Hemisphere's population, and a combined purchasing power parity of almost \$2.02 trillion, or about 77.8% of South America's total purchasing power parity. Brazil accounted for about 71% of MERCOSUR's population and about 66% of its purchasing power parity (U.S. Central Intelligence Agency, 2004§). Most multinational companies considered this growing trade bloc, which followed the North America Free Trade Agreement (NAFTA) and the European Union, to be extremely important because of its size and the amount of trade that takes place in the region. In 2003, NAFTA had an impact on

Latin America and Caribbean Basin trade, which increased to about \$109 billion, or about 58% higher than that of 1991 (\$63 billion). MERCOSUR had an impact on intraregional trade, which increased to about \$35 billion in 2003 from \$7 billion in 1983. Intra-MERCOSUR trade amounted to \$25 billion, and mineral trade amounted to \$1.8 billion (Departamento Nacional de Produção Mineral, 2004a, p. 12-13).

In 2003, Brazil sold almost 20% of its exports to the other MERCOSUR members and 30% to the other countries in Latin America. Total minerals trade between the major players of MERCOSUR, Brazil (\$1.1 billion) and Argentina (\$700 million), amounted to \$1.8 billion. Brazilian mineral imports were valued at \$11.3 billion, or almost 11.0% lower than those of 2001 (\$12.7 billion), and its total mineral exports were \$14.2 billion, or about 17.4% higher than those of 2001 (\$12.1 billion). The values of the principal exports were \$3.3 billion for iron ore and pellets; \$2.9 billion, steel products; and \$1.3 billion, aluminum. In addition to petroleum and derivatives and natural gas (\$6.5 billion), other major mineral imports (\$4.2 billion) were, in order of importance, coal, potash, phosphate rock, copper, salt, and zinc (Departamento Nacional de Produção Mineral, 2004a, p. 25-26; Ferraz, 2004, p. 11).

Brazil-U.S. trade relations during the past decade grew at an unprecedented rate. U.S. imports were primarily manufactured and semimanufactured goods of high aggregate value, such as steel and chemical products. Brazilian exports to Europe and Japan consisted mostly of raw materials, which were, in order of importance, iron ore, manganese, marble, and granite and agricultural commodities.

In 2003, total mineral trade between Brazil and the United States was \$4.5 billion. Exports increased slightly by 3.3% to \$3.4 billion, and imports decreased by about 20.1% to \$1.1 billion. Brazil's mineral trade balance with the United States increased to a surplus of \$2.6 billion from a surplus of \$2.3 billion in 2002 (Departamento Nacional de Produção Mineral, 2004a, p. 22).

Brazil's leading trading partner, followed by the United States, became China (\$6.5 billion) in 2003. Bilateral trade between Brazil and China increased to almost \$8.0 billion, or by about 79% compared with that of 2002. Brazilian exports to China amounted to \$5.8 billion, or by almost 95%, compared with those of 2002. Chinese exports to Brazil were \$2.2 billion, or about 46%. In 2003, Brazilian exports to China included, in order of importance, soybean, iron ore, steel, airplanes, buses, auto parts, pulp, tobacco, and timber. China's main exports to Brazil included, in order of importance, coke, coal, electronic parts, equipment for energy transmission, and products and material for audiovisual machinery. The CVRD and China's Metal Company of Baoshan, which was a leading company in Shanghai, formed a joint venture in 2002 to explore for iron ore in Brazil. Brazil's wealth of natural resources and China's need for raw materials to fuel its economy could become the path to establish a Sino-Brazilian trade partnership in the foreseeable future (Latin Trade, 2004).

Structure of the Mineral Industry

The mineral industry of Brazil was large by world standards. Brazilian corporations, private Brazilian investors, and/or foreign companies partially or wholly owned the major portion of the industry. The exceptions were the natural gas and petroleum industries, which were 100% Government owned through Petrobrás, which comprised five subsidiaries. Petrobrás Distribuidora S.A. distributed petroleum products; Petrobrás Gás S.A. produced, traded, and distributed natural and liquefied natural gas and fertilizers; Petrobrás Internacional, S.A. operated in foreign countries; Petrobrás Química, S.A. was the integrated refining-petrochemical operations company; and Petrobrás Transporte S.A. constructed and operated the pipelines, terminals, vessels, and facilities needed for the transportation and storage of oil and derivatives, natural gas, and bulk products (Petróleo Brasileiro S.A., 2004, p. 10-29).

The structure of the Brazilian mineral industry continued to change to a privately owned/Government-regulated regime from one that was Government-owned/Government-operated. Between 1991 and 2002, the Government privatized CVRD, the electrical energy and telecommunications sectors, and the steel industry. In addition, 40 cement companies were operating 64 cement plants and 7 grinding plants with a clinker capacity of 45 Mt in 22 States, and 30 iron ore mining companies were operating 80 mines and 43 processing plants (Departamento Nacional de Produção Mineral, 2004d, p. 52-70).

In 2003, Brazil's total labor force was nearly 80 million. Of this total, services represented 53%; industry, 24%; and agriculture, 23%. The unemployment rate was 12.2% (U.S. Central Intelligence Agency, 2004§). The minerals sector employed about 5% (960,000) of the industry total (19.2 million); this did not include the nearly 650,000 active *garimpeiros* (Vale, 2004, p. 1). Employment in the mining sector continued its downward trend as Brazil's economy was affected by its recent slow economic recovery, Argentina's economic crisis, and the increases of efficiencies and productivities in the private sector that resulted from the joint ventures, mergers, and privatizations, particularly in the mining, oil and gas, and steel sectors (table 2).

Commodity Review

Metals

Aluminum and Bauxite and Alumina.—Alumina production was more than 5.1 Mt, which was about 27.5% higher than that of 2002. Alumínio do Norte do Brasil S.A. (Alunorte) produced 48%, Alcoa Alumínio S.A. (Alcoa), 23%; Companhia Brasileira de Alumínio (CBA), 12.3%; Billiton plc, 11%; and Alcan Alumínio do Brasil S.A., 5.7%. Exports were 1.8 Mt valued at \$280 million. CBA invested \$700 million to produce 500,000 metric tons per year (t/yr) of alumina and expanded its aluminum capacity to 340,000 t/yr from 220,000 t/yr. In 2003, the Alunorte alumina refinery, which was operated by a consortium led by Vale do Sul Alumínio S.A. (Aluvale) (57.03%), Norsk Hydro Comercio e Industria (34.03%), Nippon Amazon Aluminum Co. (4.05%), CBA (3.62%), and others

(1.27%), sold 1.6 Mt of alumina (Departamento Nacional de Produção Mineral, 2004d, p. 37; Ferraz, 2004, p. 2-3; Associação Brasileira do Alumínio, 2004a§).

Primary aluminum production amounted to about 1.4 Mt of metal, or 5.5% higher than that of 2002. Primary aluminum producers were Albras (CVRD, 51%, and Nippon Amazon, 49%) which produced 29.8%; CBA, 23.7%; Alcoa, 20.3%; Billiton, 12.1%; Alcan, 7.6%; and Aluvale, 6.5%. The Alcoa's Alumar smelter (Alcoa, 53.66%, and BHP Billiton, 46.34%) at Sao Paulo produced 248,800 t; the Aluvale plant (Aluvale, 54.5% and BHP Billiton, 45.5%) at Santa Cruz, Rio de Janeiro, 52,000 t; the Alcoa plant at Pocos de Caldas, State of Minas Gerais, 94,000 t; and the Aratu facilities in Bahia and Alcan's at Ouro Preto in the State of Minas Gerais produced 58,000 t and 51,000 t, respectively. In 2003, Brazil imported 91,000 t of all forms of aluminum valued at \$320,000 million; this was almost 19% less than in 2002. Exports were 990,600 t at a value of \$1.6 billion; this was 12.3% higher than that of 2002 (Departamento Nacional de Produção Mineral, 2004d, p. 36; Ferraz, 2004, p. 3; Associação Brasileira do Alumínio, 2004c§).

Bauxite production was 17.4 Mt, which was 38.1% higher than that of the previous year. The MRN joint venture, which was owned by CVRD (40%), Billiton (14.8%), Alcoa (13.2%), Alcan (12%), CBA (10%), Norsk Hydro (5%), and Reynolds Alumínio do Brasil (5%), accounted for about 84.2% of the total bauxite production for 2003. Exports amounted to 4.7 Mt of bauxite at a value of \$127 million (Departamento Nacional de Produção Mineral, 2004d, p. 36-37; Ferraz, 2004, p. 2-3; Associação Brasileira do Alumínio, 2004b§).

MRN planned to open its new mine, which has bauxite reserves of 800 Mt and a capacity of 2 million metric tons per year (Mt/yr), in the Papagalo plateau, Trombetas, State of Para. The Papagalo Mine will maintain MRN's total bauxite ore production capacity at about 6.5 Mt/yr. CVRD was planning to invest \$320 million in the Paragominas bauxite mine, which contains 878 Mt of reserves, to produce 4.5 Mt/yr by 2005. The Albras facility at Vila do Conde, State of Para (CVRD, 51%, and Nippon Amazon, 49%), produced 346,000 t of primary metal in 2003; the facility's capacity was to be expanded to 440,000 t/yr at a cost of about \$100 million in the near future. Alcan invested \$370 million in expansions of its complex facility at Laminacao de Pindamonhangaba in the State of Sao Paulo to increase its production capacity to 280,000 t/yr from 120,000 t/yr. The Alcoa aluminum smelter's capacity was expanded to 239,000 t/yr from 194,000 t/yr in 2002 at a cost of \$550 million. Alcan expanded its aluminum sheet production capacity to 120,000 t/yr from 100,000 t/yr in 2002 as a part of a \$380 million investment program and increased its primary capacity to 150,000 t/yr. Investments in the aluminum sector could reach up to \$1.6 billion within the next few years. Latapack-Ball S.A., which produced aluminum cans, invested \$5 million to increase its plant capacity in Jacarei, State of Sao Paulo, to 2 billion aluminum cans from 1.7 billion. Brazil recycled 89% of all the aluminum cans, which was equivalent to 123,900 t of aluminum cans, or about 9.2 billion units; this was an increase of 2.3% compared with that of 2002 (Ferraz, 2004, p. 3; Associação Brasileira do Alumínio, 2004d§).

Columbium (Niobium) and Tantalum.—Brazil continued to be the world's most significant producer and main supplier of columbium (niobium) to the global markets. In 2003, Brazil produced about 91.0% of the world's total output, or 37,707 t of pyrochlore (Nb_2O_5 content) in concentrates, 24,875 t of columbium (niobium) in alloys, and 5,064 t of columbium (niobium) in oxides from three open pits located in Araxa, State of Minas Gerais, and Catalao and Ouvidor, State of Goias. In 2003, Mineração Catalao de Goiás Ltda. (MCGL) (a joint venture of Bozzano Simonsen S.A. of Brazil, 68.5%, and Anglo American, 31.5%) and Companhia Brasileira de Metalurgia e Mineração (CBMM) (a joint venture of Grupo Moreira Sales S.A. of Brazil, 55%, and Molycorp, Inc. of the United States, 45%) accounted for 61.5% and 38.5%, respectively, of Brazil's 65,000-t/yr pyrochlore production capacity. The columbium (niobium) plants of CBMM in Araxa and MCGL in Ouvidor accounted for about 88% of Brazil's pyrochlore production and supplied about 79% of the world demand for ferrocolumbium. The Araxa, Catalao, and Ouvidor columbium (niobium) ore deposits contained 97.8% (5.2 Mt) of the world's pyrochlore reserves. In 2003, Araxa produced 28,643 t, Ouvidor, 8,349 t, and Catalao, 715 t (Nb_2O_5 content) in concentrates (Departamento Nacional de Produção Mineral, 2004d, p. 96).

In 2003, tantalum production totaled 249 t (Ta_2O_5 content) in concentrates. The Pitinga Mine, which was owned by Mineração Taboca/AM, was considered to be one of the world's leading (88,760 t Ta_2O_5) and most economically viable ore bodies, produced 178.6 t, or 72%, of Brazil's tantalum output; Companhia Industrial Fluminense de Minas Gerais (American Metallurgy Group, 100%) produced 20.4 t; and Garimpeiros in the State of Para, 50 t. The upward trend in tantalum supply will continue in response to increased world demand (Departamento Nacional de Produção Mineral, 2004d, p. 116-117).

Copper.—Copper concentrate production amounted to 26,275 t, which was a decrease of almost 20% compared with that of 2002 (32,711 t). The concentrate was produced by Mineração Caraiba S/A's deposit in Jaguarari, State of Bahia, which was Brazil's only underground copper mine and was owned by Grupo PARANAPANEMA (GP) (Departamento Nacional de Produção Mineral, 2004d, p. 54; Ferraz, 2004, p. 5).

In 2003, Caraiba Metais S/A (CMSA) of Camacari, State of Bahia, which was the only electrolytic copper producer in Brazil, produced 173,378 t of primary copper metal; this was a decrease of about 8.6% compared with that of 2002 (189,651 t). This electrolytic copper output included 463,124 t of copper concentrates imported from Chile (75%), Peru (8%), and other countries (17%). To meet Brazil's metal copper demand of 255,251 t/yr, CMSA imported 125,800 t of copper cathode mostly from Chile (85%) and Peru (13%) in 2003. CMSA was planning to produce about 500,000 t/yr of electrolytic copper in D'Avila, State of Bahia, by 2010 (Departamento Nacional de Produção Mineral, 2004d, p. 54-55; Ferraz, 2004, p. 5).

In 2003, the reserves at Cobre Salobo, which was Brazil's largest copper project, were estimated to be 1,900 Mt at a grade of 0.65% copper and contained 0.96% copper equivalent associated with, in order of value, gold, silver, and molybdenum. These reserves could support a 250,000-t/yr production capacity of refined copper with byproducts of, in order of added value, gold, silver, and molybdenum. The project, which is in Maraba, State of Para, was a joint venture of CVRD (99.0%) and the Brazilian Banco Nacional de Desenvolvimento Econômico e Social (1.0%) (Departamento Nacional de Produção Mineral, 2004d p. 55). A feasibility study on Mineração Maracá S.A.'s Chapada copper project in Alto Horizonte, State of Goias, estimated that its ore reserves were 434.5 Mt and

contained 1.3 Mt of copper and 9.6 t of gold. Cristalino and Corpo Alemão in Carajás, State of Pará, were being explored by Mineração Serra do Sossego S.A., which was a joint venture between CVRD and Phelps Dodge; current (2003) resources of copper were estimated to be 400 Mt at a grade of 1.14% copper and 0.34 gram per metric ton gold. The Cobre Sossego project was under construction and was expected to produce 140,000 t of copper and 3 t of gold by 2004 (Departamento Nacional de Produção Mineral, 2004d, p. 55; Ferraz, 2004, p. 5-6).

Brazil's refined copper production was used primarily in the automobile and construction industries. Exports amounted to 83,200 t of copper metal at a value of \$131.5 million, which went to the United States (64%) and Argentina and Chile (18% each) (Departamento Nacional de Produção Mineral, 2004d, p. 54-55).

Gold.—Gold production was reported by the DNPM to be 40.4 t; mining companies produced 26 t, and garimpeiros, 14.4 t; the total gold output was 1.3 t lower than that of 2002; this was a decrease of 3.1% (table 1). Gold production from the garimpeiros increased because of higher prices and in spite of higher production costs and much higher environmental standards. Refined gold from the São Bento Mine was extracted by a combination of pressure oxidation and bioleaching (the Biox process, which had been developed by Gold Fields Ltd. and Mintek Ltd. of South Africa). Production at the São Vicente Mine will be expanded to about 10 t of gold during 2004 (Departamento Nacional de Produção Mineral, 2004d, p. 100-101).

AngloGold Limited spent \$50 million to implement the Amapari gold project in the State of Amapá and \$6 million to explore for gold near to the Pedra Branca do Amapari in the Amazon region. Desert Sun Mining Corporation (DSM), which was a junior Canadian company, formed a joint venture with Jacobina Mineração e Comércio (JMC) of Bahia on the Serra do Corrego gold property, which would require a capital outlay of \$4 million by 2004. DSM's share in the joint venture would be 51%, and JMC's, 49% (Departamento Nacional de Produção Mineral, 2004d, p. 101).

Iron and Steel.—*Ferroalloys.*—Ferroalloys production decreased slightly to 849,700 t in 2003 from 859,440 t in 2002, or by about 1.0%. Brazil's Prometal Produtos Metalúrgicos S.A. took Norway's Elkem A/S, which was one of the world's leading manganese alloy producers, as a partner to produce a projected 500,000 t of ferromanganese by 2004; the project, in which Elkem will hold a 40% share, was in Marabá, State of Pará. The manganese will come from the nearby Prometal Mine, and the iron ore will come from the Carajás District. Nova Era Silicon S.A. [a joint venture among CVRD (49%), Mitsubishi Corp. and Kawasaki Steel Corp. both of Japan (25.5%, each)] was building a silicon ferroalloy plant with an installed capacity of 48,000 t/yr in Nova Era, State of Minas Gerais. About two-thirds of its output will be exported mainly to Japan between 2003 and 2010 (Departamento Nacional de Produção Mineral, 2004d, p. 72).

Iron Ore.—Brazil produced 234.5 Mt of beneficiated iron ore compared with 214.6 t in 2002. About 95% of that production was from the major iron ore companies—CVRD, Minerações Brasileiras Reunidas S/A (MBR) (equally owned by CVRD and Mitsui & Co. Ltd. of Japan), which was Brazil's second leading producer of iron ore with a capacity to produce 31 Mt/yr; Ferteço Mineração S.A.; S.A. Mineração da Trindade (SAMITRI); Samarco Mineração S.A.; CSN; and V & M Mineração Ltda. In 2003, Brazil exported 132 Mt of iron ore and 123 Mt of pellets valued at \$2.1 billion and \$1.1 billion, respectively (Departamento Nacional de Produção Mineral, 2004d, p. 71; Ferraz, 2004, p. 7).

The total iron ore exports were 7% higher than those of 2002 and were shipped to 40 countries worldwide. Total export revenues increased by almost 4% from \$3 billion in 2002. The major importers of Brazilian iron ore were Japan (17%), China (16%), Germany (13%), Italy (6%), and France (5%). The customized (varied chemical characteristics) commercial products sold were sinter feed and pellet feed (69%), pellets (22%), and lump ore (9%) (Departamento Nacional de Produção Mineral, 2004d, p. 71).

CVRD and Pohang Iron and Steel Co. of the Republic of Korea invested \$220 million to produce 4 Mt/yr of pellets. The facility was in the port of Tubarão, State of Espírito Santo. CVRD was planning a new \$400 million pelletizing plant with railroad and port facilities in São Luiz, State of Maranhão. MBR opened three new mines—Capão Xavier, Capitão do Mato, and Tamandua—in the State of Minas Gerais to increase capacity to 32 Mt/yr in late 2003 and to offset the iron ore depletion at the Aguas Claras and Matuca Mines after 40 years of operation. Mineração Corumbense S.A. (a subsidiary of Rio Tinto) was planning a \$200 million plant at Corumbá in the State of Mato Grosso to produce 1 Mt/yr of hot-briquetted iron to supply steel plants in Argentina. This facility will use natural gas from the 3,150-kilometer (km) pipeline between Bolivia and Brazil that connects the Santa Cruz de la Sierra, Bolivia, to Campinas, State of São Paulo (Departamento Nacional de Produção Mineral, 2004d, p. 71).

CVRD consolidated the following acquisitions: Mineração Socoimex Ltda. (100%), which had the capacity to produce 7 Mt/yr of iron ore, for \$48 million; SAMITRI (51%) for \$711 million; Gulf Industrial Company of Brazil (50%), which was the owner of a pellet plant in Bahrain with a 4-Mt/yr capacity, \$92 million; and Caemi Mineração e Metalurgia S.A. (Caemi) (50%) for \$279 million. Caemi was a nonoperational holding firm; MBR controlled 85%. CVRD started up its 12th iron ore pellet plant in the Port of Ponta de Madeira, State of Maranhão, with a capacity to produce 6 Mt/yr. CVRD will inject about \$6 billion into the mining sector by 2007 to consolidate its leading position in the global iron ore market (Ferraz, 2004, p. 7).

Pig Iron.—Brazil produced 32.4 Mt of pig iron, which was about 9.1% higher than that of 2002. The 4.5 Mt of exports, which was valued at \$475 million, was approximately one-third of the pig iron traded in the world (Confederação Nacional do Comércio, 2004, p. 27; Departamento Nacional de Produção Mineral, 2004d, p. 72).

Steel.—For the year, raw steel production amounted to 31.1 Mt, which represented an increase of 5.2% compared with that of 2002. Brazil was the eighth leading producer and exporter of steel worldwide (Confederação Nacional do Comércio, 2004, p. 27; Departamento Nacional de Produção Mineral, 2004d, p. 72-73; Instituto Brasileiro de Siderurgia, 2004, p. 8). Apparent domestic consumption of steel was about 16 Mt, which represented a decrease of 3.2% compared with that of 2002. The major recipients of Brazil's exports were Asia (6 Mt), Latin America (2.4 Mt), the United States (2.1 Mt), and Europe (1.4 Mt). The Instituto Brasileiro de Siderurgia (IBS) stressed that the Brazilian steel industry had become more efficient because privatization had fundamentally

improved efficiency and reduced employment levels in the Brazilian steel industry. The IBS believed that vertical integration was evident as customers and suppliers of the steel companies participated in the auctions (Instituto Brasileiro de Siderurgia, 2004, p. 16). CVRD and Nucor Corp. signed a nonbinding memorandum of cooperation to advance their own interests in potential iron and steel business opportunities in the Americas, which may become available as a result of the restructuring of the North American steel industry. Baosteel and CVRD were planning to sign an agreement in early 2004 to invest \$1.4 billion in an integrated mill that would produce 4 Mt of steel slabs (Ferraz, 2004, p. 7; Latin Trade, 2004).

Manganese.—In 2003, Brazil produced 2.5 Mt of manganese ore, which was about the same level as that of 2002. CVRD's high-grade manganese mine Igarape Azul in the Carajas Complex accounted for 75% of metallurgical manganese production, which was about 17% higher than that of 2002 (1.8 Mt). Construtora Polares Ltda., which was a medium-sized producer, and small-sized producers in, in order of importance, the States of Minas Gerais, Goiás, and Bahia produced 177,000 t of manganese ore, which was 0.5% higher than that of 2002. Exports of manganese ore accounted for 900,000 t at a value of \$41 million; this was about the same level as that of 2002 because of the lower demand for steel in Brazil and by MERCOSUR. Manganese ferroalloys exports increased by about 20%, which amounted to 150,000 t at a value of \$63 million (Departamento Nacional de Produção Mineral, 2004d, p. 89).

Nickel.—Brazil produced about 3.8 Mt of nickel ore, which was a decrease of more than 1.3% compared with that of 2002. Production of electrolytic nickel, nickel in ferronickel alloys, and nickel in matte increased to 30,514 in 2003 from 29,976 t in 2002. Mineração Serra da Fortaleza, which was located in Fortaleza de Minas, State of Minas Gerais, and was owned by Rio Tinto, produced 6,300 t of nickel contained in matte, which was 35% lower than that of the previous year. Companhia Niquel Tocantins of Grupo Votorantin (GV) in Niquelandia, State of Goiás, produced 18,100 t of nickel contained in carbonates obtained by ammoniacal leaching a hydrometallurgical process; this was about 6% higher than that of 2002. In the same district, CODEMIN S.A. (owned by Anglo American) produced 6,100 t of nickel contained in ferronickel alloy, which was 1.4% higher than that of 2002 (Departamento Nacional de Produção Mineral, 2004d, p. 99; Ferraz, 2004, p. 7-8).

Owing to the increase in world demand for stainless steel and higher nickel prices, investments of \$1.5 billion in the Brazilian nickel industry were to increase the production capacity to 107,000 t/yr by 2004 from 34,000 t/yr in 2002. CVRD intended to invest \$600 million to produce 40,000 t/yr of nickel metal from its Vermehlo project in Carajas, State of Para, which contained reserves of 100 Mt at a grade of 1.5% nickel. Anglo American will develop the Barro Alto nickel project in the State of Goiás by investing \$750 million to produce 40,000 t/yr of nickel from a deposit with 117 Mt at a grade of 1.5% nickel. Companhia Niquel Tocantins will double production capacity in Niquelandia, State of Goiás, to 20,000 t/yr at a cost of \$50 million. Falconbridge Limited of Canada, which was world's third leading producer of refined nickel, entered into exploration negotiations with the Brazilian Government for sulfide and lateritic nickel in the country in 2000; thus far, Falconbridge has invested \$500,000 for preliminary research and map collection with CPRM and DNPM (Departamento Nacional de Produção Mineral, 2004d, p. 81-82).

Tin.—Brazil was the world's fourth leading tin producer after China, Peru, and Indonesia (Carlin, 2004). Tin production was 12,217 t of tin contained in concentrate compared with 12,023 t in 2002, and 10,761 t of metal compared with 11,675 t in 2002. During the past 5 years, production cuts were made at the Pitinga Mine in the State of Amazonas, which was operated by Marmoré S.A. and owned by GP, and at the garimpeiros' Bom Futuro operations in the State of Rondonia; Amazonas (72%) and Rondonia (25%) continued to be the major producers in the country. Marmoré's mine produced 9,800 t compared with 9,600 t in 2002; byproducts were, in order of importance, columbium (niobium), tantalum, zirconium, hafnium, thorium, and cryolite. Marmoré was planning to develop its Rocha Sa project to increase total tin ore output to 14,300 t/yr by 2004. Exports decreased to 6,042 t valued at \$22.3 million from 6,432 t valued at \$25.9 million in 2002. During the past 5 years, the highest exports were registered in 1997 (11,957 t valued at \$62.5 million). Manufactured goods were shipped to Argentina (80%), and semimanufactured goods, to the United States (82%) (Departamento Nacional de Produção Mineral, 2004d, p. 66-67; Ferraz, 2004, p. 8).

Zinc.—Brazil produced 152,823 t of zinc content in concentrates, which was about 12.0% higher than that of 2002. Grupo Votorantin's (GV) Companhia Mineira de Metais S.A. (CMM), which was the only producer of zinc ore in Brazil, produced 124,847 t of zinc silicate in Vazante, which was almost 18.0% higher than that of 2002, and 30,232 t of zinc sulfide concentrates in Paracatu, which remained at about the same level as that of 2002 (Departamento Nacional de Produção Mineral, 2004d, p. 128-129). The concentrates were processed in CMM's plant in Tres Marias and GP's Juiz de Fora Complex; both are located in the State of Minas Gerais. These zinc refineries produced 257,230 t of primary metal, which was about 4.0% higher than that of 2002. CMM produced 167,735 t, which was 8.3% higher than that of 2002, and GP's Companhia Paraibuna de Metais S.A. produced 89,795 t (35% of the total), which was 3.3% lower than that of 2002 (Departamento Nacional de Produção Mineral, 2004d, p. 128; Ferraz, 2004, p. 8).

To meet Brazil's demand for zinc, which was about 217,600 t/yr of metal, the country imported 260,586 t of zinc concentrates (valued at \$65.8 million), which was slightly higher than that of 2002, and 19,850 t of metal, which remained at about the same level as that of 2002. Peru supplied 88% of the concentrates and 43% of the metal; additional zinc metal was supplied by Argentina (38%) and Spain (7%) (Departamento Nacional de Produção Mineral, 2004d, p. 128; Ferraz, 2004, p. 8).

In 2003, the Tres Marias zinc refinery capacity was increased to 165,000 t/yr from 120,000 t/yr in 2002, which amounted to an investment of \$100 million. Additional zinc reserves in Paracatu was added at a cost of \$8 million. CMM was planning to expand capacity to 240,000 t/yr by 2004. GV acquired Cia. Paraibuna de Metais for \$66 million and became the only zinc producer in the country (Departamento Nacional de Produção Mineral, 2004d, p. 129; Ferraz, 2004, p. 8).

Asbestos.—Brazil's significant asbestos deposits were in Cana Brava, Minacu, State of Goiás; Goiás was the only producing State in the country. Sociedade Anônima Mineração de Amianto produced 231,117 t of asbestos fiber, which was 18.7% higher than that of 2002. Almost 95% of Brazil's asbestos production was consumed in the manufacture of specialized cement products, which were, in order of importance, ceiling tiles, protective screens, water and sewer pipes, water tanks, and molded electrical insulators. Other uses were, in order of importance, thermal insulators, paper and cardboard, slabs, decorations, insecticide, asphalt for highways and airport runways, and the automobile industry (Departamento Nacional de Produção Mineral, 2004d, p. 56-57).

Brazil exported about 46.3% of its production mainly to Thailand (32%), India (17%), Mexico (10%), and Indonesia and Iran (9% each); these exports, however, remained at about the same levels as those of 2002. The State of São Paulo was the country's leading consumer followed by the States of Paraná and Rio Grande do Sul. Asbestos mining and consumption have been highly regulated in most industrialized nations, thus forcing them to reduce production and consumption. Industry experts expected asbestos use in the industrial nations to continue to decline. In contrast, the world's developing economies were expected to increase their collective asbestos consumption by large margins. Brazilian asbestos reserves (16 Mt) were considered to be adequate to meet demand in the short-to-medium term; the average grade of ore from the Cana Brava Mine in Minacu was 5.2%, and its reserves (fiber content only) were 3 Mt, which, at a production rate of about 200,000 t/yr, represented a 15-year mine life (Departamento Nacional de Produção Mineral, 2004d, p. 56-57).

Cement.—The country produced 34 Mt of cement, which was 10.5% lower than that of 2002 (38 Mt). Among the 22 State producers, Minas Gerais was the most important with 23.4% of the total followed by São Paulo (15.8%), Paraná (11.6%), Rio de Janeiro (7.1%), Sergipe (5.2%), Rio Grande do Sul (5.0%), Brasília (4.8%), Paraíba (4.0%), Ceará (3.6%), Espírito Santo (3.5%), and other States (16.0%). The main producers were GV's Companhia Cimento Portland Itau (41.4%) and Grupo João Santos (12.4%); other producers included Companhia Cimento Portland Rio Branco (9.9%), Grupo Swiss Holderbank's Holder Cimento S.A. (8.8%), Camargo Correia Cimentos S.A. (7.9%), and Grupo Lafarge's Companhia Cimento Portland Paraíso (6.6%). The exported cement (586,997 t) went to the United States (45%), Paraguay (28%), Bolivia (18%), Argentina (3%), Nigeria (2%), and other countries (4%). Brazil imported 612,762 t of cement from the United States (38%), Cuba (17%), Thailand (14%), Venezuela (10%), Spain (7%), and other countries (14%). Camargo Correia Cimentos invested \$200 million to build a 1.6-Mt/yr cement plant in Ijaci, State of Minas Gerais. Grupo Cimentos Portland S/A will invest \$180 million to build two cement plants in the State of Paraíba and will produce 1.7 Mt/yr of cement by early 2004 (Departamento Nacional de Produção Mineral, 2004d, p. 52-53).

Clays.—*Kaolin.*—In Brazil, kaolin consumption decreased by about 25.5% to 237,223 t from 318,408 t in 2002. Kaolin was used mainly in the ceramics and paper industries and, to a lesser degree, in the manufacture of animal feed, fertilizers, food supplements and pharmaceuticals, paint, pesticides, plastics, and rubber. Brazil had 4,050 Mt of kaolin reserves, or about 29% of the world's total. Production of beneficiated kaolin was about 2.1 Mt, which was 18.4 higher than that of 2002. The beneficiated kaolin was either coating or filler kaolin. In 2003, Ymerys Rio Campin Caulim S.A. accounted for 38.5% of the country's total output followed by Caulim da Amazônia S.A. (CADAM) (35.8%) and Pará Pigmentos S.A. (PPSA) (21.3%); the remainder was produced by small producers in the States of Minas Gerais, Rio Grande do Sul, and São Paulo. Brazilian kaolin exports were about 1.9 Mt valued at \$205 million compared with about 1.4 Mt valued at \$162 million. Exports were made to Belgium (30%), Japan and the United States (15% each), Finland (10%), the Netherlands (9%), and other countries (21%). CADAM increased production of coating kaolin to 800,000 t in 2003 and was expected to increase it to 1 Mt/yr by 2005 with an investment of \$30 million. PPSA initiated expansions that would increase its capacity to 600,000 t/yr at a cost of \$22.5 million (Departamento Nacional de Produção Mineral, 2004d, p. 48-49).

Fluorspar.—Production of beneficiated fluorspar totaled 48,100 t, which was less than 1% higher than that of 2002 (47,900 t). The beneficiated fluorspar was either acid or metallurgical grade. Crude ore [run-of-mine (ROM)] production was 132,000 t, which was about the same level as that of 2002. The ROM production remained at about the same level as that of 2002 despite the shutdown of Mineração Nossa Senhora do Carmo Ltda.'s (MNSCL) Fumaça and Pedras Grandes fluorspar mines. The ROM production, by mine, in the State of Santa Catarina was Morro de Fumaça (42%), Santa Rosa de Lima (33%), and Rio Fortuna (10%) and in Rio de Janeiro State, Tanguá (15%). MNSCL was planning to acquire Mineração Del Rey Ltda.'s Cerro Azul Mine in the State of Paraná to increase domestic production in 2004 (Departamento Nacional de Produção Mineral, 2004d, p. 74-75).

Gemstones.—Brazil continued to be one of the world's leading gemstone producers and exporters. Many different varieties of gemstones are found throughout the country; these include, in order of importance, emerald, aquamarine, diamond, amethyst, citrine, chrysoberyl, opal, topaz, agate, and tourmaline. Brazil is the world's only source of some quality gemstones, such as imperial topaz and Paraíba tourmaline (Oliveira, 2004).

In 2003, the mining of gemstones continued to be dominated by the garimpeiros. Brazilian production totaled 1.1 million carats, which was mainly derived from digging activities (garimpos) that amounted to 460,000 carats, or 42% of the total and the private sector produced 40,000 carats, or 8% of the total (table 1). Garimpeiros' production, however, continued to decline because of depleting garimpos' reserves and increasing environmental restrictions. During 2002-03, some high-content gem placers in indigenous reserves were closed by the Government to exploration, the jewelry industry's gemstone consumption was unknown, taxation on domestic sales of jewelry was high, and the private sector faced severe competition from its black-market counterparts. Taking into consideration these factors, Brazil's gemstone reserves were almost impossible to quantify. Brazil, however, may have great potential because it has 700 million cubic meters of sedimentary rocks that contain diamond that grade between 0.01 and 0.1 carat per cubic meter, or 17.5 million carats; this represented about 1.2% of the world's diamond reserve base (Departamento Nacional

de Produção Mineral, 2004d, p. 60-61; Olson, 2004a). Diamond production remained at about the same level as that of 2002 (500,000 carats) (table 1). The total value of gemstone production was \$50 million. Total exports of uncut gemstones were about \$26.2 million compared with \$32.7 million in 2002 and \$34.6 million in 1997. The major markets for uncut stones were Belgium (57%) and the United States (24%), and those for cut stones, the United States (30%), Chile and Peru (10% each), and Argentina (6%). Imports increased to \$23.4 million from \$20.3 million in 2002. The main sources of uncut stones were Ireland (59%), the United States (31%), and Hong Kong and the United Kingdom (2% each), and those of cut stones, China (23%), Italy (18%), the United States (11%), and Austria and Japan (10% each). Brazil had lapidarian centers, many of which have closed owing to the preference of foreign buyers for uncut stones (Departamento Nacional de Produção Mineral, 2004d, p. 60).

Graphite.—Historically, Brazil's beneficiated natural graphite output has been centered in the State of Minas Gerais. Nacional de Grafite Ltda. (NGL) mined natural graphite in the municipalities of Pedra Azul, which had a production capacity of 60,000 t/yr; Itapecerica, 11,000 t/yr; and Salto da Divisa, 6,000 t/yr. Production amounted to 70,739 t with 14% carbon content; this was 16.2% higher than that of 2002 (60,922 t). This production was mainly of products that ranged in grade from 65.5% to 99.9% carbon at NGL's plants—Pedra Azul (30,000 t/yr), Itapecerica (10,800 t/yr), and Salto da Divisa (6,000 t/yr). Grafita MG Ltda. produced about 12,800 t of natural graphite, which was similar to that of 2002; the natural graphite was consumed domestically after simple grinding (Departamento Nacional de Produção Mineral, 2004d, p. 82-83).

Three types of beneficiated graphite products (fines, lump, and medium-grained) were processed by NGL in Itapecerica and Pedra Azul. Brazil's demand for natural flake-type crystalline graphite was met by the Itapecerica, Pedra Azul, and Salto da Divisa beneficiation plants. Exports amounted to 13,291 t valued at \$12.3 million in 2003 compared with 12,778 t valued at about \$11.8 million in 2002. Growth of the domestic consumption of natural graphite in the 2000s was related to that of the iron and steel industries, which absorbed about 80% of the natural graphite consumed in Brazil; demand in 2003 (49,000 t) remained at about the same level as that of 2002. Other consumers included battery manufacturing (6.5%), refractories (6%), paint and varnishes (2%), and other uses (5.5%) (Departamento Nacional de Produção Mineral, 2004d, p. 82-83).

Magnesium.—The most important magnesite mine in Brazil was the Pedra Preta Mine, which was owned and operated by Magnesita S.A. (MSA); the mine is located in the Eguas Mountain region of Brumado, State of Bahia, and about 610 km from the port of Salvador. Brazil produced 269,000 t of beneficiated magnesite, which was about the same level as that of 2002; MSA produced 98%, or 263,620 t. Exports of processed magnesite totaled 72,000 t at a value of \$10 million and were shipped mostly to Poland (26%), Paraguay (22%), Argentina (17%), Chile (11%), and Germany (9%). Imports of processed magnesite totaled 7,500 t at a value of \$4.5 million and were imported mostly from Canada (54%), China (11%), the United States (10%), and Israel and Mexico (8% each). By yearend (2003), about 630 Mt of resources with 180 Mt of magnesium content had been identified (Departamento Nacional de Produção Mineral, 2004d, p. 86-87).

Phosphate Rock.—Production of phosphate rock concentrate amounted to about 4.9 Mt, which was about the same level as that of 2002. Production was highly concentrated (94%, or 4.6 Mt) in four mining companies—Fosfertil S.A. (Grupo Fertifós) (34%), Fertilizantes Serrana S.A. (Bunge International Group) (30%), and Copebras S.A. (Anglo American) and Ultrafertil (Grupo Fertifós) (15% each). Fosfertil and Ultrafertil were controlled by Grupo Fertifós (81.54%) and CVRD (10.96%). Bunge International Group controlled Fertifós (100%), Fertilizantes Serrana S.A. (52%), Cargill S.A. (33%), and Fertibrás S.A. (13%). The reported domestic consumption of concentrates was about 6.0 Mt/yr; this was an increase of 2.2% compared with that of 2002. Of the total phosphoric acid produced, 73% was used in the fertilizer industry; 25%, in the chemical industry, and 2%, for other uses; these usages remained almost unchanged from those of 2002. Brazil's demand for fertilizers increased to a record of 19.5 Mt in 2003; this was an increase of 2.1% compared with that of 2002. Although domestic production of fertilizers increased to 8.5 Mt from 7.5 Mt in 2002, Brazil continued its dependency on imports. Imports of concentrates, phosphoric acid, and intermediate products were valued at \$585.0 million compared with \$557.4 million in 2002 (Departamento Nacional de Produção Mineral, 2004d, p. 76-77; Ferraz, 2004, p. 9).

Quartz.—Brazil produced 4,300 t of quartz, which was about the same level as that of 2002. Quartz was exported mostly to Spain (20%), Hong Kong (18%), Canada (11%), and Portugal (10%). Quartz powder was shipped mainly to Germany (67%), the United Kingdom (18%), and the United States (11%). Telequartz Exportação S.A. and others produced quartz powder, which is an important constituent in the production of, in order of importance, optic fibers, crucibles, oscillators, solar cells, wafers and integrated circuit packing, and ceramic materials of exceptional purity. Brazil's reserves were estimated to be 53 Mt (Departamento Nacional de Produção Mineral, 2004d, p. 108-109).

Salt.—The reported domestic production of salt was 6.1 Mt, which was about the same level as that of 2002. The State of Rio Grande do Norte continued to be the major producer of marine salt with 97% followed by the States of Rio de Janeiro (2%) and Ceara (1%). The domestic consumption of salt was 5.6 Mt. Brazil also produced 1.3 Mt of rock salt. Salgema Mineração e Química S.A. in Maceio, State of Alagoas, produced 680,000 t (52%) of rock salt, and Dow Química do Nordeste Ltd. (a subsidiary of Dow Chemical Co. of the United States) produced 620,000 t (48%) of salt from the Vera Cruz Mine in the State of Bahia (Departamento Nacional de Produção Mineral, 2004d, p. 112-113).

In 2003, salt imports increased to 250,000 t from 220,000 t, or by 13.6%, in 2002. Imports were sea salt (3,000 t) and bulk without aggregates (217,000 t), in order of importance, table salt, sodium chloride, and pure sodium. Imports came from Chile (99%) and other countries (1%). Salt exports amounted to 695,000 t, which remained at about the same level as that of 2002 (694,000 t). Exports were sea salt (688,000 t), table salt (4,000 t), and bulk without aggregates (3,000 t). Exports were shipped to Nigeria (59%), the United States (29%), Venezuela (5%), Belgium (4%), and Uruguay (3%). Salt was consumed by the chemical industry (chlorine and sodium manufacture) (85%) and others (caustic soda) (15%) (Departamento Nacional de Produção Mineral, 2004d, p. 112-113).

Other Industrial Minerals.—Gypsum.—Production of gypsum was more than 1.6 Mt, which was about the same level as that of 2002. In Brazil, renewed housing and infrastructure construction activities increased the consumption of cement and plasters (Departamento Nacional de Produção Mineral, 2004d, p. 80-81).

Potassium.—Potassium production decreased slightly to 627,000 t from 627,310 t in 2002. Brazil imported 2.6 Mt of potash mainly from Russia (29%), Canada (25%), Germany (20%), and Israel (18%) (Departamento Nacional de Produção Mineral, 2004d, p. 104-105).

Talc.—Production of talc was 395,000 t, which was about 1.3% higher than that of 2002. The State of Bahia was Brazil's major talc producer with 53% of the national output followed by Parana (23%), Sao Paulo (20%), Rio Grande do Sul (3.0%), and Minas Gerais (1%) (Departamento Nacional de Produção Mineral, 2004d, p. 114-115).

Mineral Fuels

Brazil produced 19.8 billion cubic meters of natural gas and 566.5 million barrels of petroleum, which were increases of 27.6% and 3.5%, respectively, compared with those of 2002. The country produced, in order of importance, crude oil, natural gas liquid, natural gas, coal, and shale oil; production totaled 623.8 million barrels of oil equivalent (Departamento Nacional de Produção Mineral, 2004d, p. 78-79; 102-103; *Petróleo Brasileiro S.A.*, 2004, p. 2). In 2003, Petrobrás' average production of crude oil, which included condensate and natural gas liquid, was about 1.710 million barrels per day (Mbbbl/d), which was 1.7% higher than that of 2002 (*Petróleo Brasileiro S.A.*, 2004, p. 2-4, 11-12).

Petrobrás was planning to increase its daily output rate to 1.9 Mbbbl by 2005 and to produce about 75% of this output from deepwater. In 2003, the supply of natural gas totaled about 36.1 million cubic meters, of which 10.5 million cubic meters, or 29.1%, was imported from Bolivia, and of the total supply, 24.8 million cubic meters, or 68.7%, was consumed in Brazil; and the remainder, or 31.3%, was used by Petrobrás (Ferraz, 2004, p. 10).

Coal.—The Brazilian coal industry's mine operations were concentrated in the three southernmost States of Santa Catarina (61%), Rio Grande do Sul (38%), and Parana (1%). In 2003, Brazilian energy-generation-type coal (marketable output) production was about the same level as that of 2002 (6 Mt) (table 1; Departamento Nacional de Produção Mineral, 2004d, p. 46).

The main producers of ROM coal were Copelmi Mineração Ltda. (2.0 Mt), Companhia Riograndense de Mineração S.A. (CRM) (1.7 Mt), Companhia Carbonífera Metropolitana S.A. (1.2 Mt), and Carbonífera Circiúma S.A. (1.1 Mt). Coal demand increased mainly because the thermoelectric plants were operating at full capacity in these three States. In 2003, domestic coal sales reached 6.0 Mt of which Santa Catarina used 52%; Rio Grande do Sul, 47%; and Parana, 1%. To meet Brazil's metallurgical coal demand, 13 Mt valued at \$633 million was imported; this was a decrease of 1.2% compared with that of 2002. Imports came from the United States (30.3%), Australia (24.5%), China (15.6%), Canada (9.2%), South Africa (4.7%), and other countries (15.7%) (Ferraz, 2004, p. 5). Brazil imported 1.6 Mt of mineral coal coke as well, which was an increase of 5.8% compared with that of 2002; China was the main supplier. Total coal consumption reached 17.1 Mt, which was about the same as that of 2002. The steel industry consumed 64.7% of metallurgical-grade coal; thermoelectric generation, 33%; and the petrochemical and pulp and paper industries, 2.3% (Departamento Nacional de Produção Mineral, 2004d, p. 47). Brazil was planning a priority thermoelectric generating program based mostly on natural gas and coal that would involve 49 new power stations based mainly on natural gas. The three plants, which will be built in the State of Rio Grande do Sul, will be coal fired. These new powerplants were part of the Government's 17-gigawatt emergency plan (supplied largely by Electrobrás S.A.) to cope with the increased demand of electricity. Circiúma and Metropolitana were negotiating with Usina Termoelétrica do Sul Catarinense to supply coal to produce 400 megawatts (MW). Most Brazilian coals have a lower content of carbon and a higher content of ash compared with the Colombian coals in the Guajira area. Total Brazilian coal reserves were estimated to be 930 Mt (Departamento Nacional de Produção Mineral, 2004d, p. 46-47; Ferraz, 2004, p. 4-5).

Natural Gas and Petroleum.—Brazil produced 54.3 million cubic meters per day of gas, which was 27.5% higher than that of 2002. The gas pipeline that links the Enchova platform in the offshore Campos Basin to Macae, State of Rio de Janeiro, added 5 million cubic meters per day of gas flow to the Rio de Janeiro and the Sao Paulo markets; offshore gas production accounted for 57% of the total. Petrobrás signed two agreements, one with YPF de Argentina and the other one with YPF de Bolivia, to supply natural gas to Brazil. The Argentina-Brazil gas pipeline linked Aldeia Brasileira in Argentina to Porto Alegre in the State of Rio Grande do Sul. The \$2 billion 3,150-km Bolivia-Brazil gas pipeline started operation and will increase the supply of natural gas along the 1,970 km of pipeline between Santa Cruz de la Sierra, Bolivia, and Porto Alegre, Brazil, to supply the States of Mato Grosso do Sul, Sao Paulo, Parana, Santa Catarina, and Rio Grande do Sul with 10.5 million cubic meters per day in 2003 and into 2005, 16 million cubic meters per day from 2005, and 30 million cubic meters per day from 2010. The natural gas share of the country's energy mix was 3% in 2003 and was expected to be 12% by 2010. Petrobrás continued producing natural gas in the Gulf of Mexico and recovered gas from the Frederick Field, which is located 27 km off the Louisiana coast (Departamento Nacional de Produção Mineral, 2004d, p. 78-79, 102; Ferraz, 2004, p. 9-10; *Petróleo Brasileiro S.A.*, 2004, p. 46).

In 2003, Petrobrás's total international production of oil and liquid natural gas amounted to 35,200 barrels per day, and natural gas output was almost 4 million cubic meters per day, which totalled 58,100 barrels of oil equivalent per day. Exploration and production took place in Angola, Argentina, Bolivia, Colombia, Equatorial Guinea, Nigeria, Trinidad and Tobago, and the United States. As a result of the acquisition of Perez Companc in 2002, Petrobrás will start exploration and production in Ecuador, Peru, and Venezuela by 2004 (*Petróleo Brasileiro S.A.*, 2004, p. 52).

Brazil produced 1.6 Mbbbl/d of petroleum, which was 53.5% higher than that of 2002. Imports of crude oil and derivatives were valued at \$3.5 billion compared with almost \$4 billion in 2002. The main sources were Nigeria (27.0%), Algeria (22.3%), Saudi

Arabia (17.3%), Iraq (10.3%), Argentina (9.3%), and other countries (13.8%) (Departamento Nacional de Produção Mineral, 2004d, p. 103; Petróleo Brasileiro S.A., 2004, p. 52).

In 2003, the partnership of Royal Dutch/Shell (80%) and Petrobrás (20%) on the Bijupira and the Salema Projects in the Campos Basin produced a combined 50,000 barrels per day of crude oil and more than 480,000 cubic meters per day of gas. The fields have reserves of about 190 million barrels of oil and 1.8 billion cubic meters of natural gas (U.S. Energy Information Administration, 2004§).

Uranium.—Brazil had the fifth leading uranium reserves in the world (Raposo dos Santos, 2002, p. 389). The country's indicated reserves amounted to 22 Mt of uranium oxide (U_3O_8) and 67 Mt of inferred reserves; minable reserves contained more than 103,200 t at a grade of 0.104% U_3O_8 . Private interests were permitted to participate in uranium operations in Brazil through state-owned joint ventures; no more than 20% of the country's uranium reserves may be exported (Departamento Nacional de Produção Mineral, 2002, p. 35, 389-391).

Reserves

Brazil was among the world leaders in reserves of some mineral commodities. According to the Departamento Nacional de Produção Mineral (2004d, p. 11), the commodities were ranked as follows: first, columbium (niobium) and tantalum; second, graphite and tin; third, aluminum, kaolin, talc, and vermiculite; fourth, magnesite and manganese; and fifth, iron ore (table 3).

Infrastructure

Brazil's railroads comprised a total of 29,412 km (1,610 km electrified) of which 4,907 km was 1.600-m gauge (942 km electrified), 194 km was 1.440-m gauge (630 km electrified), and 23,915 km was 1.000-m gauge (581 km electrified). In addition, three rails had dual gauge—396 km of 1.000- and 1.600-m gauge (78 km electrified). The country had a total of almost 2 million kilometers of roads—94,871 km was paved and 1.8 million kilometers was gravel and dirt. Brazil had 50,000 km of navigable inland waterways. The major shipping ports were Belem, Fortaleza, Ilheus, Manaus, Paranagua, Porto Alegre, Recife, Rio de Janeiro, Rio Grande, Salvador, Santos, and Vitoria. Among the merchant marine's 271 ships, 82 were bulk vessels; 56, tankers; 15, chemical tankers; 14, combination ore and oil vessels; 10, liquefied gas tankers; and 2, combination bulk vessels. Brazil had 3,803 airports of which 677 had paved runways and 3,047, unpaved (Vale, 2004, p. 18-23; U.S. Central Intelligence Agency, 2004§).

In 2003, Brazil's installed electrical generating capacity was 52,865 MW. Total production of electric power for the year was 321,200 gigawatt-hours, which translated into 1,370 kilowatt-hours per capita. Brazil's primary domestic energy supply encompassed the following: hydroelectric, 82.7%; petroleum and natural gas, 8.3%; nuclear energy, 4.4%; and others, 4.6% (Vale, 2004, p. 18-23; U.S. Central Intelligence Agency, 2004§).

The Bolivia-Brazil pipeline, which was owned by a consortium of Royal Dutch/Shell, Enron Energy Corp., and Petrobrás, was the leading of the various cross-border energy projects. Argentina supplied gas to the State of Rio Grande do Sul's new thermoelectric plant, two additional pipelines were to take Argentine gas to Brazil's southern market, and another project was to supply energy to Brazil from a powerplant in Uruguay. The total pipeline network was 15,772 km of which 7,920 km consisted of crude oil and petroleum products, and 5,252 km, of gas, which excluded the Brazilian side (2,600 km) of the Bolivia-Brazil gas pipeline. In northern Brazil, a transmission line supplied energy to the State of Roraima from Venezuela. The majority of these projects were being developed by the private sector as a result of globalization, liberalization, and privatization. State-owned corporations entered into partnerships with private domestic and foreign investors (Petróleo Brasileiro S.A., 2004, p. 37).

Negotiations were completed between the Brazilian Government and five companies, four of which were foreign subsidiaries. The companies involved were Alcan, Alcoa, Billiton, Camargo Corrêa Industrial S.A. (Brazil), and Dow Chemical, USA. Brazil and the five companies will build a 1,200-MW dam, which will be named Tucuruí, on the Tocantins River on the border between the States of Maranhão and Tocantins. Construction of the dam was estimated to cost about \$1 billion; Billiton pledged \$350 million (Vale, 2004, p. 23).

This new dam appeared to be necessary because demand for hydroelectricity was growing at a rate faster than that of supply. The supply of subsidized electricity in the Tocantins area was exceeded by the industrial and mining activities in 2003. The 10% electrical subsidy was expected to be phased out by 2004. Alcoa acquired ownership of one concession as part of a consortium, and Alcan obtained the right to build three hydroelectric power stations (Vale, 2004 p. 20).

The aluminum companies won the right to build new hydroelectric plants in the auction of the Agência Nacional de Energia Elétrica (ANEEL). They secured eight concessions that will demand a total investment of more than \$1 billion. In the auction of ANEEL, Alcan secured the right to build hydroelectric plants at Barra dos Coqueiros and Cacu in the State of Goiás, and Traira II in the State of Minas Gerais. Alcan planned to invest \$180 million in their construction. Alcan will pay \$1.3 million per year for the concession of the 60-MW Traira I plant (Ferraz, 2004, p. 3-4).

Constran S.A. and Construção e Comércio of Grupo Itamaraty planned to construct an additional 1,718 km of railroad to be linked to the existing railroad system. The cost of the new system was projected to be \$2.5 billion. This addition will connect to the existing system that runs through Vitoria, State of Espírito Santo; Belo Horizonte, State of Minas Gerais; Santos, State of São Paulo; and Chapadao do Sul, State of Mato Grosso do Sul. This new railroad system will run from Chapadao do Sul to Cuiabá, Mato Grosso and Santarém, State of Pará, and will branch from Cuiabá to Porto Velho, State of Rondônia (Vale, 2004, p. 22).

Outlook

Brazil will continue to be a strong economy in Latin America and one of the world's most important producers of bauxite, columbium (niobium), graphite, iron ore, manganese, tantalum, and tin. Future hydroelectric and thermoelectric powerplants coming onstream are expected to meet Brazil's energy needs. After the administration introduced fiscal austerity policies by giving priority to such reforms as the country's complex tax code, trimming the civil service pension system, and continuing the fight against inflation, the Brazilian Real has recovered in value. As an exporter of mineral commodities, the country is poised to gain from the continued depreciation of the Real caused by the financial risks, which were, in part, triggered by the more-severe crisis in Argentina. Brazil's share of the region's net FDI inflows decreased to \$21.5 billion in 2003 from \$26.5 billion in 2002 and \$38.5 billion in 2001, which reflected the uneasiness in the financial markets owing to the slowdown of the leading economies in the world. Oil companies were hesitant to invest in Brazil because of fiscal uncertainties on the Federal and State levels. The Federal tax that provides tax exemption on imports of equipment for crude oil exploration, development, and production (Repetro) was to expire in 2007, but oil companies were anxious for Repetro to be extended by the current Administration (U.S. Energy Information Administration, 2004§). The Agência Nacional do Petróleo is, however, planning to extend Repetro to 2020, and oil companies and other investors have showed confidence in the country, which will support continued economic growth and investments in technology well into the next decade. Deferral of major investment decisions has not been reported by the Brazilian Government. Even firms that have financed with borrowed capital, such as CVRD, have the natural hedge provided by their mineral resources and exports. CVRD is planning to invest about \$6 billion in mineral project developments and acquisitions into 2007. The significance of the investment would be to increase CVRD's market capitalization to \$25 billion from its current (2003) level of about \$10 billion (Banco Central do Brasil, 2004§).

The various sectors of the Brazilian economy have recorded diverse rates of growth—minerals, 3.4%; agriculture, 3.0%; services, 2.5%; and industrial, 0.6 % (Departamento Nacional de Produção Mineral, 2004a, p. 1; Ferraz, 2004, p. 1; Banco Central do Brasil, 2004§). The positive rate of economic growth in the minerals sector is likely to be sustained into 2004 and beyond if expansion in the demand for mineral exports and fabricated steel goods continues. MERCOSUR has undergone dramatic changes in natural gas and power markets owing to the increase in cross-border energy investment opportunities, domestic gas consumption, and internationalization of the energy sector. Brazil has become the center of an increasingly rapid process of energy integration in South America owing to the country's gas market, which is in full evolutionary mode with an unsatisfied energy demand and a great potential for growth.

Investments in the Brazilian mining industry are expected to continue to enhance exploration and mine development activities, particularly in, in order of importance, iron ore, gold, copper, diamond, and emeralds. This trend should continue because several corporations have been forming consortiums and acquiring exploration properties, mining prospects, and permits particularly for, in order of importance, oil and gas, iron ore, gold, diamond, and base metals.

Brazilian gold production could increase significantly in the foreseeable future because of the growth of Brazilian copper production and increased interest by domestic and foreign investors in largely unexplored areas. More than 2,500 gold occurrences, which are mostly Precambrian vein deposits and alluvial placers, are known (Departamento Nacional de Produção Mineral, 2004d, p. 101; Ferraz, 2004, p. 6).

After privatization of CVRD, the steel industry, and other sectors of the Brazilian economy, such as energy, services, telecommunications, and transportation, new projects in the oil and gas sectors will continue to be opened up to mergers and joint-venture projects with domestic and foreign investors. As a result, the Brazilian economy is expected to remain sustainable and competitive within a more-inclusive globalization process in the years to come.

Brazil's dynamic and diverse economy coupled with its sizable consuming market and its membership in MERCOSUR is expected to continue to attract the interest of domestic and international investors. Worldwide trade was expected to increase as the Brazilian economy recovers and domestic demand increases. Brazil would like to expand its current (2003) bilateral trade with East Asia by gaining access to other growing economies, such as China, Japan, and the Republic of Korea, which could be worth \$15 billion per year (Latin Trade, 2004).

Brazil has a strong industrial base that is capable of supplying most of the required mining and oil and gas equipment, has a modern and reliable transportation and communication systems, and can provide skilled labor, modern mining and oil and new technologies, and an efficient network of supporting services. Improvements and additional infrastructure, however, would have a direct impact on Brazil's ability to increase, in order of importance, metal, industrial minerals, and mineral fuels production and competitive trade.

The aluminum, automobile, petrochemical, pulp and paper, and steel industries which depend heavily on energy and exports, will likely benefit most from additional and improved power-generating infrastructure. The 52 powerplants to be built in the foreseeable future (49 based on natural gas and 3 on coal) would become the major driver for growth in mineral fuels demand. In early 2002, the Government eliminated all price controls and import tariffs on petroleum and derivatives to motivate private investment and to increase competition that would benefit the Brazilian economy. Petrobrás is expected to build additional refineries with the participation of new partners from the private sector.

The Amazon region continued to offer potential for major undiscovered mineral wealth in addition to the large reserves of, in order of value, iron ore, manganese, bauxite, gold, and tin. A factor that may place constraints on mineral development over the longer term, however, is the concern over biodiversity in the Amazon Rainforest, which comprises 30% of the world's remaining tropical forests, provides shelter to 10% of the globe's plant and animal species, and removes excess carbon dioxide from the atmosphere (U.S. Energy Information Administration, 2003§; 2004§). Much will depend on the approaches to be used for economic and social development while protecting the environment in a sustainable way.

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Rua General Severiano
90 Botafogo-ZC-02
22290-Rio de Janeiro-RJ-Brasil
- Companhia de Pesquisa de Recursos Minerais
Avenida Pasteur 404-Anexo, 2º Andar, Praia Vermelha
22290-Rio de Janeiro-RJ-Brasil
- Conselho de Não-Ferrosos e de Siderurgia
Esplanados dos Ministerios-Bloco 6-5º Andar
70053-Brasília-DF-Brasil

Conselho Nacional do Petróleo
SGAN-Q.603 Modulos J, I e H
70830-Brasilia-DF-Brasil
Departamento Nacional de Produção Mineral
Ministério da Minas e Energia
SAN-Quadra 01-Bloco "B"
70040-Brasilia-DF-Brasil
Instituto Brasileiro de Mineração
Avenida Afonso Pena, 3880 3º, 4º e 5º Andares
30000-Belo Horizonte-MG-Brasil
Instituto Brasileiro de Siderurgia
Rua Araújo Porto Alegre, 36 - 7º Andar
20030-010-Rio de Janeiro-RJ-Brasil
Petróleo Brasileiro, S.A.
Avenida República do Chile, 65
20035-Rio de Janeiro-RJ-Brasil
Rio Doce Geológica e Mineração, S.A.
Avenida President Wilson 11º Andar
22030-Rio de Janeiro-RJ-Brasil

Major Publications

Associação Brasileira dos Produtores de Ferroligas (ABRAFE), Sao Paulo: ABRAFE Yearbook, annual.
Departamento Nacional da Produção Mineral, Brasilia: Anuario and Sumario Mineral, annual.
Fairchild Publications, New York: American Metal Market, weekly.
Instituto Latinoamericano del Fierro y el Acero, Santiago: Monthly and annual reports.
Metal Bulletin Journals Ltd., London:
Metal Bulletin, semiweekly.
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TABLE 1
BRAZIL: PRODUCTION OF MINERAL COMMODITIES^{1,2}

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003 ^c
METALS					
Aluminum:					
Bauxite, dry basis, gross weight	13,839,000	13,846,000	13,790,000	13,189,000	13,147,900 ³
Alumina	3,515,000	3,743,000	3,445,000	3,962,000	3,960,000 ³
Metal:					
Primary	1,249,600	1,277,000	1,140,000	1,318,400 ^r	1,380,600 ³
Secondary	190,000	210,000	200,000	215,000	253,500 ³
Beryllium, beryl concentrate, gross weight	11	13	13 ^e	11	11
Cadmium, metal, primary ^e	12 ^r	12 ^r	15 ^r	37 ^r	243 ³
Chromium:					
Crude ore	457,579 ^r	550,000 ^r	418,402 ^r	284,000 ^r	390,640 ³
Concentrate and lump, Cr ₂ O ₃ content	207,123	253,248	178,013	113,811	114,000
Marketable product ⁴	103,015	70,040	38,472	11,186	12,000
Cobalt:					
Mine output, Co content of hydroxide ^e	400	900	900	900	900
Metal, electrolytic ⁵	651 ^r	792 ^r	889 ^r	960 ^r	960
Columbium (niobium)-tantalum ores and concentrates, gross weight:					
Columbite and tantalite ^e	330	330	330	330	330
Djalsmaite concentrate ^e	10	10	10	10	10
Pyrochlore concentrate, Nb ₂ O ₅ content	31,352	31,190	39,039	41,303	41,300
Copper:					
Mine output, Cu content	31,371	31,786	30,111	30,642	27,300 ³
Metal, refined:					
Primary	193,014	185,345	212,243	189,651	174,200 ³
Secondary	54,220	47,500	36,000	23,000	23,000
Gold:					
Mine output kilograms	42,367	42,025	46,001	32,886	39,400
Garimpeiros, independent miners do.	10,267	8,368	5,866	5,000	5,000
Total do.	52,634	50,393	51,867	37,886	44,400
Iron and steel:					
Iron ore and concentrate, marketable product: ⁶					
Gross weight thousand tons	194,000	212,576	201,438 ^r	214,560 ^r	234,478 ^r
Fe content do.	128,040	141,106	133,713 ^r	142,468 ^r	155,693 ^r
Metal:					
Pig iron do.	24,781 ^r	27,952 ^r	27,623 ^r	29,899 ^r	32,500 ^r
Ferroalloys, electric arc furnace:					
Chromium metal	NA ^r	NA ^r	NA ^r	NA ^r	NA
Ferrocilcium silicon	NA ^r	NA ^r	NA ^r	NA ^r	NA
Ferromanganese	78,874 ^r	134,562	84,428	123,175 ^r	125,500 ³
Ferromanganese silicon	11,910 ^r	7,790 ^r	5,899 ^r	10,522 ^r	10,500
Ferrocolumbium	28,557 ^r	27,359 ^r	37,411 ^r	36,450 ^r	34,200
Ferromanganese	85,260 ^r	121,277	96,016	156,435 ^r	149,000
Ferromolybdenum	NA ^r	NA ^r	NA ^r	NA ^r	NA
Ferronickel	19,807 ^r	19,315 ^r	17,966 ^r	19,874 ^r	19,900
Ferrophosphorus	NA ^r	NA ^r	NA ^r	NA ^r	NA
Ferrosilicon	200,833 ^r	189,935 ^r	159,345	145,910 ^r	146,000
Ferrosilicon magnesium	9,882 ^r	9,658 ^r	11,032 ^r	14,552 ^r	14,600
Ferrosilicon zirconium	-- ^r	-- ^r	-- ^r	NA ^r	NA
Ferrotitanium	NA ^r	NA ^r	NA ^r	NA ^r	NA
Ferrotungsten	NA ^r	NA ^r	NA ^r	NA ^r	NA
Ferrovandium	NA ^r	NA ^r	NA ^r	NA ^r	NA
Inoculant	16,642 ^r	20,232 ^r	14,684 ^r	11,100 ^r	11,100
Silicomanganese	148,384 ^r	171,304	180,235	182,731 ^r	180,200 ³
Silicon metal	136,572 ^r	166,344	112,123	133,390 ^r	133,400 ³
Other ferroalloys	25,479	35,190	16,623	25,300	25,300
Total	762,200 ^r	902,966 ^r	735,762 ^r	859,439 ^r	850,000
Crude steel, excluding castings thousand tons	24,600	27,865	26,718	29,604	29,600
Semimanufactures, flat and nonflat do.	25,000 ^e	25,000 ^e	18,006	17,460	17,500

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES^{1,2}

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003 ^c
METALS--Continued:					
Lead:					
Mine output, Pb content in concentrate	10,281	8,832	10,725 ^r	9,253	10,652 ^r
Metal, secondary	52,000	50,000	47,000	50,000	50,000
Manganese:					
Ore and concentrate, marketable, gross weight ⁴	1,656,000	2,192,000	2,200,000 ^c	2,500,000	2,500,000
Metal: ^c					
Primary	6,500	6,500	6,500	6,500	6,500
Secondary	1,600	1,600	1,600	1,600	1,600
Nickel:					
Mine output, ore	2,990,657	2,790,184	3,923,456	3,873,474	2,659,272 ³
Ni content in ore	41,522	45,317	45,300	45,300	31,100
Ferronickel, Ni content	6,502	6,347	5,768	6,011	6,010
Rare-earth metals, monazite concentrate, gross weight ^c	200	200	200	200	200
Silver ⁷ kilograms	42,000	41,000	46,046	33,000	35,000
Tin:					
Mine output, Sn content	13,202	14,200 ^r	12,500 ^r	11,994 ^r	12,000
Metal, smelter:					
Primary	12,787	13,825	12,168 ^r	11,675	11,500
Secondary ^c	250	250	250	250	250
Titanium:					
Ilmenite:					
Gross weight	96,000	123,000	111,113	174,382	174,000
TiO ₂ content	51,748	66,303	59,895	94,000	93,800
Rutile, gross weight	4,300	3,162	1,791	2,645	2,650
Tungsten, mine output, W content	13	18	22	24	24
Zinc:					
Mine output, Zn content	98,590	100,254	111,432	136,430	136,000
Metal, smelter:					
Primary	187,010	191,777	197,037 ^r	249,434	250,000
Secondary ^c	7,000	7,000	7,000	7,000	7,000
Zirconium, zircon concentrate, gross weight ⁸	27,160	29,805	20,553	20,000	20,500
INDUSTRIAL MINERALS					
Asbestos:					
Crude ore ^c	3,950,000	3,950,000	3,950,000	3,950,000	3,950,000
Fiber	188,386	209,332	172,695	194,732	194,750 ³
Barite:					
Crude	48,789	55,462	63,882	63,953	64,000
Beneficiated	44,906	53,741	54,790	54,895	55,000
Marketable product ^{c,4}	65,000	65,000	65,000	65,000	65,000
Calcite ^c	35,000	35,000	35,000	35,000	35,000
Cement, hydraulic thousand tons	40,270	39,208	38,927	38,027	38,000
Clays:					
Bentonite, beneficiated	274,623	273,975	160,381	174,909	175,000
Kaolin:					
Crude	3,598,326	3,740,815 ^r	4,146,511	3,953,455	3,954,000 ³
Beneficiated	1,516,700	1,639,673 ^r	1,817,419	1,708,457	1,708,500 ³
Marketable product ⁴	1,156,593	1,390,636	1,437,399	1,444,159	1,444,200 ³
Diamond: ^c					
Gem thousand carats	900 ³	1,000 ³	700	500 ³	500
Industrial minerals: do.	600	600	600	600	600
Total ⁹ do.	1,500 ³	1,600 ³	1,300	1,100	1,100
Diatomite:					
Crude	14,601	10,164	10,010	8,030	8,030
Beneficiated	7,867	7,201	6,976	5,835	5,840
Marketable product ^{c,4}	13,100	131,000	13,100	13,100	13,100

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES^{1,2}

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003 ^c
INDUSTRIAL MINERALS--Continued:					
Feldspar:					
Crude	220,000	227,215	150,000	150,000	150,000
Marketable product: ^{c, 4}					
Feldspar	122,000	117,715 ³	75,000 ³	75,000 ³	75,000
Leucite	5,000	5,000	5,000	5,000	5,000
Sodalite, crude	500	500	500	500	500
Total	128,000	123,215 ^{r, 3}	80,500 ³	80,500 ³	80,500
Fluorspar:					
Crude ore	98,000	130,976	124,021	131,975	132,000
Concentrates, marketable product:					
Acid-grade	38,209	30,131	31,263	32,774	33,000
Metallurgical-grade	6,717	12,831	12,471	15,125	15,100
Total	44,926	42,962	43,734	47,899	48,100
Graphite:					
Crude ^c	650,000	650,000	650,000	650,000	650,000
Marketable product:					
Direct-shipping ore	NA	NA	NA	NA	NA
Concentrate	53,503	71,208	70,091	60,922	61,000
Total	53,503	71,208	70,091	60,922	61,000
Gypsum and anhydrite, crude	1,527,599	1,497,790	1,506,619	1,633,311	1,630,000
Kyanite: ^c					
Crude	750	750	750	750	750
Marketable product ⁴	600	600	600	600	600
Lime, hydrated and quicklime thousand tons	6,137	6,273	6,300 ^c	6,500	6,500
Lithium, concentrates	11,122	10,875	9,084	12,046	12,046
Magnesite:					
Crude	868,604	1,006,654	1,079,207	1,084,786	1,090,000
Beneficiated	259,834	279,876	265,749	269,222	269,000
Mica, all grades	3,000	4,000	4,000 ^c	4,000 ^c	4,000
Nitrogen, N content of ammonia ^c	948,000	950,000	950,000	950,000	950,000
Phosphate rock including apatite:					
Crude:					
Mine product thousand tons	27,000 ^c	26,300	26,740	31,494	31,500
Of which sold directly ^c do.	35	35	35	35	35
Concentrate:					
Gross weight do.	4,344	4,725	4,805	4,883	4,900
P ₂ O ₅ content do.	1,543	1,687	1,707	1,738	1,700
Pigment, mineral, other, crude ^c	2,000	2,000	2,000	2,000	2,000
Potassium (KCl)	580,380	654,168	594,930	627,310	627,000
Potash, marketable (K ₂ O)	348,231	351,681	318,585	337,266	337,300 ³
Phosphate rock including apatite:					
Precious and semiprecious stones except diamond, crude and worked: ^c					
Agate	3,000	3,000	3,000	3,000	3,000
Amethyst	1,000	1,000	1,000	1,000	1,000
Aquamarine	20	20	20	20	20
Citrine	100	100	100	100	100
Emerald	90	90	90	90	90
Opal	500	500	500	500	500
Ruby value	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000
Sapphire do.	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000
Topaz	50	50	50	50	50
Tourmaline	80	80	80	80	80
Other	500	500	500	500	500
Quartz crystal, all grades	1,470	3,651	4,350	4,300 ³	4,300

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES^{1,2}

(Metric tons unless otherwise specified)

Commodity	1999	2000	2001	2002	2003 ^c
INDUSTRIAL MINERALS--Continued:					
Salt:					
Marine thousand tons	4,528	4,626	4,370	4,835	4,840
Rock do.	1,430	1,448	1,208	1,274	1,270
Silica, silix ^c	1,600	1,600	1,600	1,600	1,600
Sodium compounds: ^c					
Caustic soda	1,050,000	1,050,000	1,050,000	1,050,000	1,050,000
Soda ash, manufactured (barilla)	200,000	200,000	200,000	200,000	200,000
Stone, sand and gravel: ^c					
Dimension stone:					
Marble, rough-cut cubic meters	200,000	200,000	200,000	200,000	200,000
Of which sold directly	50,000	50,000	50,000	50,000	50,000
Crushed and broken stone:					
Basalt cubic meters	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Calcareous shells	450,000	450,000	450,000	450,000	450,000
Dolomite thousand tons	3,500	3,500	3,500	3,500	3,500
Gneiss cubic meters	1,100,000	1,100,000	1,100,000	1,100,000	1,100,000
Granite thousand cubic meters	60,000	60,000	60,000	60,000	60,000
Limestone thousand tons	60,000	60,000	60,000	60,000	60,000
Quartz ¹⁰	250,000	250,000	250,000	250,000	250,000
Quartzite:					
Crude	400,000	400,000	400,000	400,000	400,000
Processed	200,000	200,000	200,000	200,000	200,000
Sand, industrial	2,700,000	2,700,000	2,700,000	2,700,000	2,700,000
Sulfur:					
Frasch	23,232	23,720	24,468	22,620	22,600
Byproduct:					
Metallurgy	217,119	217,238	280,079	284,184	284,000
Petroleum	57,962	81,762	80,125	77,185	77,200
Total	298,313	322,720	384,672	383,989	384,000
Talc and related material:					
Talc:					
Crude	294,000	300,000	370,500	390,000 ^e	395,000
Marketable product ^{c,4}	2,000	2,000	2,000	2,000	2,000
Pyrophyllite, crude	160,000	150,000	189,500	200,000 ^e	200,000
Vermiculite:					
Concentrate	23,400	24,074	21,464	22,577	22,600
Marketable product ⁵	3,100	3,100	3,100 ^e	3,100 ^e	3,100
MINERAL FUELS AND RELATED MATERIALS					
Coal, bituminous:					
Run-of-mine thousand tons	12,340 ^r	14,335 ^r	13,800 ^e	13,800 ^e	13,800
Marketable ⁵ do.	6,013 ^r	6,000 ^r	6,000 ^r	6,000 ^r	6,000
Coke, metallurgical, all types do.	50	50	50 ^e	50 ^e	50
Natural gas, gross million cubic meters	11,898	13,247 ^r	13,988 ^r	15,525 ^r	19,345 ³
Natural gas liquids thousand 42-gallon barrels	3,345	3,694	5,860	5,860 ^e	5,865 ³
Petroleum:					
Crude thousand 42-gallon barrels	413,121	464,280	487,640 ^r	547,135	620,865 ³
Refinery products: ^{11,12}					
Liquefied petroleum gas (LPG) do.	10,950	13,140	14,112	13,274 ^r	13,503 ³
Gasoline do.	128,854	134,722	144,691	136,108 ^r	138,452 ³
Jet fuel do.	533	557	598	562 ^r	576 ³
Kerosene do.	25,064	26,175	28,112	26,444 ^r	26,900 ³
Distillate fuel oil do.	198,106	206,885	222,221	209,040 ^r	212,640 ³
Lubricants do.	5,584	5,831	6,315	5,941 ^r	6,043 ³
Residual fuel oil do.	115,406	118,698	127,482	119,920 ^r	121,985 ³
Other do.	94,758	100,893	108,359	101,931 ^r	103,686 ³
Refinery fuel and losses do.	NA	NA	NA	NA	NA ³
Total do.	579,255	606,901	651,890	613,220 ^r	623,785 ³

See footnotes at end of table.

TABLE 1--Continued
BRAZIL: PRODUCTION OF MINERAL COMMODITIES^{1,2}

⁶Estimated; estimated data are rounded to no more than three significant digits; may not add to total shown. [†]Revised. NA Not available. -- Zero.

¹Table includes data available through October 2004.

²In addition to the commodities listed, bismuth, molybdenite, and uranium oxide are produced, but output is not reported; and available information is inadequate to make reliable estimates of output levels.

³Direct sales and/or beneficiated (marketable product).

⁴Source: Cobalt Development Institute.

⁵Includes sponge iron, in metric tons, as follows: 1998-2003--270,000 (estimated).

⁶Reported figure.

⁷Officially reported output; of total production, the following quantities are identified as secondary silver (the balance being silver content of other ores and concentrates), in kilograms: 1999-2002--50,000.

⁸Includes baddeleyite-caldasite.

⁹Figures represent officially reported output plus official Brazilian estimates of output by nonreporting miners.

¹⁰Apparently includes crude quartz used to produce quartz crystal (listed separately in this table) and additional quantities of common quartz.

¹¹Figures represent officially reported production to the United Nations (Energy Statistics Yearbook) by the Ministry of Mines and Energy of Brazil.

¹²Minerals Questionnaire, 1998-2002, and Petrobrás Magazine, 1999-2003.

TABLE 2
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2003

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS			
Aluminum	Albras-Alumínio Brasileiro S.A. (Albras) [Companhia Vale do Rio Doce (CVRD), 51%, and Nippon Amazon Alumínio Co. (NAAC), 49%]	Belém and Vila do Conde, Pará State (two smelters)	440 (metal).
Do.	Alcan Alumínio do Brasil S.A. [Alcan Aluminum Ltd. (Alcan), 100%]	Saramenha, Minas Gerais State (smelter and refinery)	100 (metal).
Do.	do.	do.	150 (alumina).
Do.	Alcan Empreendimentos Ltda. (Alcan Alumínio do Brasil S.A., 100%)	Laminação de Pindamonhangaba, São Paulo State (smelter)	280 (metal).
Do.	Alcan Alumínio Poços de Caldas (Alucaldas) (Alcan Alumínio do Brasil S.A., 100%)	Poços de Caldas, Minas Gerais State (mine)	1,000 (bauxite).
Do.	Alcoa Alumínio S.A. [Aluminum Co. of America (Alcoa), 54%; BHP Billiton plc, 36%; Alcan, 10%]	do.	400 (bauxite).
Do.	do.	São Luiz, Maranhão State (refinery)	550 (alumina).
Do.	do.	São Luiz, Maranhão State (smelter)	239 (metal).
Do.	Alumínio do Brasil Nordeste S.A. (Alcan Aluminum Ltd., 100%)	Aratu, Bahia State (smelter)	120 (metal).
Do.	Billiton Metais S.A. (Billiton plc, 100%)	São Luis, Maranhão State (refinery)	375 (metal); 450 (alumina).
Do.	Alumínio do Norte do Brasil S.A. (Alunorte) (private, 100%)	Barcarena, Pará State (refinery)	2,400 (alumina).
Do.	Companhia Brasileira de Alumínio (CBA) (private, 100%)	Poços de Caldas, Minas Gerais State (mine)	1,000 (bauxite).
Do.	do.	Sorocaba, São Paulo State (refinery)	500 (alumina).
Do.	do.	Sorocaba, São Paulo State (smelter)	340 (metal).
Do.	Companhia Geral do Minas (Aluminum Co. of America, 79%, and others, 21%)	Poços de Caldas, Minas Gerais State (refinery)	275 (alumina).
Do.	do.	Poços de Caldas, Minas Gerais State (smelter)	90 (metal).
Do.	Mineração Rio do Norte S.A. (MRN) (Companhia Vale do Rio Doce, 40%; Billiton plc, 14.8%; Alcoa, 13.2%; Alcan Empreendimentos Ltda., 12%; Companhia Brasileira de Alumínio, 10%; Norsk Hydro Comercio e Industria, 5%; Reynolds Alumino do Brasil, 5%)	Oriximina, Pará State (mine)	14,500 (bauxite).
Do.	do.	Papagalo, Pará State (mine)	2,000 (bauxite).
Do.	do.	Trombetas, Pará State (mine)	2,000 (bauxite).
Do.	Vale do Sul Alumínio S.A. (Aluvale) (Government, 27%; private, 25%; Shell do Brasil S.A., 44%)	Santa Cruz, Rio de Janeiro State (smelter)	86 (metal).
Do.	Aluvale (Companhia Vale do Rio Doce, 49.7%; Billiton Metais S.A., 41.5%; Cia. Cataguazes, 8.8%)	do.	93 (metal).
Do.	Reynolds Internacional do Brasil (Reynolds, 42.5%; Bradesco Bank, 42.5%; J.P. Morgan, 15%)	Sorocaba, São Paulo State (smelter)	5.4 million (cans).
Do.	Consortium Paragominas S.A. (Companhia Vale do Rio Doce, 48.7%; Mineração Rio do Norte S.A., 24.6%; Nippon Amazon Aluminum Co., 12.2%; Companhia Brasileira de Alumínio, 5.7%; others, 8.8%)	Jabuti, Pará State (mine)	4,500 (bauxite).
Do.	do.	Jabuti, Pará State (alumina)	1,200 (alumina).
Chromite	Coítezeiro Mineração S.A. (COMISA) (private, 75.4%, and Bayer do Brasil S.A., 24.6%)	Campo Formosa, Bahia State (mine)	50 (ore).
Do.	Companhia de Ferro Ligas da Bahia (FERBASA) (private, 100%)	Campo Formoso, Bahia State (mine)	370 (ore).
Do.	do.	do.	292 (concentrate).
Columbium	Companhia Brasileira de Metalurgia e Mineração (Grupo Moreira Sales S.A., 55%, and Molycorp, Inc., 45%)	Araxá, Minas Gerais State (mine)	120 (ore).
Do.	do.	Araxá, Minas Gerais State (beneficiation plant)	50 (pyrochlore).
Do.	Mineração Catalão de Goiás Ltda. (MCGL) (Bozzano Simosen S.A., 68.5%, and Anglo American plc, 31.5%)	Ouvidor and Catalão I, Goiás State (mines)	70 (ore).
Do.	do.	Ouvidor, Goiás State (plants)	13 (pyrochlore).

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2003

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS--Continued			
Copper	Mineração Caraíba S/A (Grupo PARANAPANEMA, 100%)	Jaguari, Bahia State (mine)	130 (ore).
Do.	do.	Jaguari, Bahia State (beneficiation plant)	90 (concentrate).
Do.	Caraíba Metais S/A (CMSA) (private, 100%).	Camaçari, Bahia State (refinery)	220 (metal).
Ferroalloys	Companhia Brasileira Carbureto de Calcio (private, 100%)	Santos Dumont, Minas Gerais State (plant)	54.
Do.	Prometal Produtos Metalúrgicos S.A., 60%, and Elkem A/S, Marabá, Pará State (plant) 40%		500.
Do.	Nova Era Silicon S.A. (Compnhia Vale do Rio Doce, 49%; Mitsubishi Corp., 25.5%; Kawasaki Steel Corp., 25.5%)	Nova Era, Minas Gerais State	48.
Do.	Companhia Ferro-Ligas de Bahia S.A. (FERBASA, 100%)	Pojuca, Bahia State (plant)	194.
Do.	Companhia Ferro-Ligas Minas Gerais (MINASLIGAS, 100%)	Pirapora, Minas Gerais State (plant)	58.
Do.	Companhia Paulista de Ferro-Ligas (CPF) (private, 100%)	Barbacena, Caxambu, Jeceaba, Passa Quatro, and Passa Vinte, Minas Gerais State; Corumba, Matto Grosso do Sul State; and Xanxere, Santa Catarina State	326.
Do.	Italmagnesio S.A. Indústria e Comercio (ISAIC) (private, 100%)	Bragança Paulista, São Paulo State; and Varzeada Palma, Minas Gerais State (two plants)	63.
Gold	kilograms Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Gold mines in the States of Minas Gerais, Bahia, and Pará	18,000.
Do.	do. Mineração Morro Velho S.A. (AngloGold Ltd., 100%)	Novo Lima, Raposos, and Sabara, Minas Gerais State; and Jacobina, Bahia State (four mines)	7,000.
Do.	do. Mineração Serra Grande S.A. (AngloGold Ltd., 50%, and TVX Gold Inc., 50%)	Serra Grande, Minas Gerais State (mine)	6,000.
Do.	do. São Bento Mineração S.A. (Eldorado Gold Corp., 100%)	Santa Barbara, Minas Gerais State (mine)	4,000.
Do.	do. Rio Paracatu Mineração S.A. (Rio Tinto plc, 51%, and Autram S/A, 49%)	Paracatu Mine, Minas Gerais State (mine)	7,500.
Do.	do. Mineração Maracá S.A. (MMSA) (private, 100%)	São Vicente Mine, Mato Grosso State (mine)	1,500.
Iron ore	Companhia Siderúrgica Nacional (CSN) (private, 100%)	Volta Mine, Minas Gerais State	12,000.
Do.	Itaminas Comércio de Minérios S.A. (private, 100%)	Itaminas, Minas Gerais State	5,000.
Do.	Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Serra dos Carajás, Pará State	55,000.
Do.	do.	Itabira, Ouro Preto, Santa Barbara, Xavier, Tamandúa, Capao, and Mato, Minas Gerais State (seven mines)	105,000.
Do.	Ferteco Mineração S.A. (FERTECO) (Exploration Bergbau GmbH, 100%)	Ouro Preto and Brumadinho, Minas Gerais State (two mines)	12,800.
Do.	S.A. Mineração da Trindade (SAMITRI) (private, 100%)	Mariana, Rio Piracicaba, Itabira, Ouro Preto, and Sabara, Minas Gerais State (five mines)	9,300.
Do.	Minerações Brasileiras Reunidas S/A (MBR) (BHP Ltd., 50%, and Mitsui Co. Ltd., 50%)	Capão Xavier, Tamandúa, and Capitão do Mato, Minas Gerais State (three mines)	32,000.
Do.	Samarco Mineração S.A. (SAMITRI, 51%, and BHP Ltd., 49%)	Alegria, Minas Gerais State (mine)	13,500.
Do.	SOCOIMEX S.A. (Companhia Vale do Rio Doce, 100%)	Mato, Minas Gerais State (mine)	7000
Lead	Mineração Boquirá S.A. (MBSA) (private, 100%)	Boquirá, Bahia State (mine)	300 (ore).
Do.	do.	Boquirá, Bahia State (beneficiation plant)	310 (concentrate).
Manganese	Companhia Vale do Rio Doce (CVRD) (CVRD-Companhia Siderúrgica Nacional, 100%)	Corumba, Minas Gerais State (mine)	2,500 (ore).
Do.	do.	Igarapé Azul, Carajás, Pará State (beneficiation plant)	1,400 (concentrate).
Do.	Urucum Mineração S.A. (Companhia Vale do Rio Doce, 100%)	Corumba and Ladario, Mato Grosso do Sul State (two mines and plant)	1,500 (ore); 800 (concentrate).
Do.	Construtora Polares Ltda. (CPL) (private, 100%)	Corumba Minas Gerais State (mine)	200 (ore).

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2003

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
METALS--Continued			
Nickel	Companhia Niquel Tocantins (Grupo Votarantin, 100%)	Niquelândia, Goiás State (mine)	20 (ore).
Do.	do.	Niquelândia, Goiás State (refinery plant)	10 (electrolytic Ni).
Do.	Mineração Serra da Fortaleza (Rio Tinto plc, 100%)	Fortaleza, Minas Gerais State (mine)	19 (nickel matte).
Do.	CODEMIN S.A. (Anglo American plc, 100%)	Niquelândia, Goiás State (refinery)	20 (metal).
Steel	Aço Minas Gerais S.A. (AÇOMINAS) (private, 100%)	Rodovia, Minas Gerais State	2,000.
Do.	Companhia Aços Especiais Itabira (Government, 90.9%, and private, 9.1%)	Timoteo, Minas Gerais State (stainless steel plant)	600.
Do.	Companhia Siderúrgica Belgo-Mineira (private, 100%)	João Monlevade, Minas Gerais State	1,000.
Do.	Companhia Siderúrgica de Tubarão (private, 100%)	Serra, Espírito Santo State	3,000.
Do.	Companhia Siderúrgica Nacional (CSN) (private, 100%)	Volta Redonda, Rio de Janeiro State	4,600.
Do.	Companhia Siderúrgica Paulista (COSIPA) (private, 100%)	Cubatão, São Paulo State	3,900.
Do.	Usinas Siderúrgicas de Minas Gerais, S.A. (USIMINAS) (private, 100%)	Ipatinga, Minas Gerais State	4,400.
Tin	Mineração Jacunda Ltda. (MJL) (private, 100%)	Santa Barbara, Novo Mundo, and Potosi, Rondônia State (six mines)	108 (ore).
Do.	do.	Santa Barbara, Novo Mundo, and Potosi, Rondônia State (three beneficiation plants)	450 (concentrate).
Do.	Grupo PARANAPANEMA (private, 100%)	Aripuana, Mato Grosso State; Ariquemes, Rondônia State; Novo Aripuana, Pitinga, and Presidente Figueiredo, Amazonas State; and São Felix do Xingu, Pará State (five mines and two plants)	5,420 (ore).
Do.	do.	Piraporada Bom Jesus, São Paulo State (refinery)	1,400 (concentrate); 25 (metal).
Do.	Marmoré S.A. (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	20 (ore).
Do.	Grupo PARANAPANEMA (private, 100%)	Aripuana, Mato Grosso State; Ariquemes, Rondônia State; Novo Aripuana, Pitinga, and Presidente Figueiredo, Amazonas State; and São Felix do Xingu, Pará State (five mines and two plants)	5,420 (ore).
Do.	do.	Piraporada Bom Jesus, São Paulo State (refinery)	1,400 (concentrate); 25 (metal).
Do.	Marmoré S.A. (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	20 (ore).
Tantatum	metric tons Mineração Taboca/AM (private, 100%)	The Pitinga Mine, Amazonas State (mine)	180 (concentrate).
Do.	do. Companhia Industrial Fluminense (private, 100%)	Fluminense Mine, Minas Gerais State (mine)	25 (concentrate).
Titanium	Rutilo e Ilmenita do Brasil S.A. (RIBSA, 100%)	Mataraca, Paraíba State (mine)	4,200 (ore).
Do.	do.	Mataraca, Paraíba State (two beneficiation plants)	120 (concentrate).
Zinc	Companhia Mineira de Metais S.A (Grupo Votarantin, 100%)	Vazante, Minas Gerais State (mine)	800 (ore).
Do.	do.	Vazante, Minas Gerais State (beneficiation plant)	48 (concentrate).
Do.	do.	Três Marias, Minas Gerais State (refinery)	165 (metal).
Do.	Companhia Paraibuna de Metais S.A (CPM) (Grupo PARANAPANEMA, 100%)	Juiz de Fora, Minas Gerais State (mine)	100 (ore).
Zirconium	Nuclemon Minero-Química Ltda. (Government, 100%)	São João da Barra, Rio de Janeiro State (mine)	660 (ore).
Do.	do.	Itapemirim, Espírito Santo State (mine)	90 (ore).
Do.	do.	Prado, Bahia State (mine)	90 (ore).
Do.	do.	Prado, Bahia State (three beneficiation plants)	123 (concentrate).
Do.	do.	Prado, Bahia State (three separation plants)	90 (concentrate).
INDUSTRIAL MINERALS			
Asbestos	Sociedade Anônima Mineração de Amianto (private, 100%)	Cana Brava and Minaçu, Goiás State (mines)	9,000 (ore).
Do.	do.	Cana Brava and Minaçu, Goiás State (beneficiation plant)	230 (concentrate).
Cement	Cimento Santa Rita S.A. (CSSA) (Cimento Santa Rita S.A., 50%, and Holder Cimento S.A., 50%)	Itapevi and Salto de Pirapora, São Paulo State (two plants)	2,200.
Do.	Companhia Cimento Portland Itau (Grupo Votarantin, 100%)	Itau de Minas, Minas Gerais State (three plants)	2,400.

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2003

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
INDUSTRIAL MINERALS-- Continued			
Cement--Continued:	Companhia de Cimento Portland Paraíso (CCPP) (Companhia de Cimento Portland Paraíso, 50%, and Lafarge Group, 50%)	States of Espírito Santo, Goiás, Minas Gerais, and Rio de Janeiro (five plants)	4,000.
Do.	Companhia de Cimento Portland Rio Branco (Grupo Votarantin, 100%)	Rio Branco do Sul, Paraná State (two plants)	5,000.
Do.	Camargo Correia Cimentos S.A. (CCSA) (private, 100%)	Ijaci, Minas Gerais State (plant)	1,600.
Diamond	Mineração Tejucana S.A. (MTSA, 100%)	Diamantina, Minas Gerais State (mine)	100.
Fluorspar	Mineração Nossa Senhora do Carmo Ltda. (private, 100%)	Cerro Azul, Paraná State (two mines)	180 (ore).
Do.	Mineração Santa Catarina Ltda. (MSCL) (private, 100%)	Morro da Fumaça, Santa Rosa de Lima, Rio Fortuna, Santa Catarina State; and Tangüá, Rio de Janeiro State (three mines and beneficiation plant)	100 (ore); 120 (concentrate).
Graphite	Nacional de Grafite Ltda. (NGL) (private, 100%)	Itapecerica, Pedra Azul, Salto da Divisa, Minas Gerais State (three mines)	80 (ore).
Do.	do.	Itapecerica, Pedra Azul, Salto da Divisa, Minas Gerais State (three beneficiation plants)	60 (concentrate).
Do.	Grafita MG Ltda. (GML) (private, 100%)	Mateus Leme, Zerra Azul, Minas Gerais State (two mines)	20 (ore).
Do.	Marmoré Mineração e Metalurgia Ltda. (MML) (Grupo PARANAPANEMA, 100%)	Maiquinique, Bahia State (mine)	10 (ore).
Gypsum	Companhia Brasileira de Equipamento (private, 100%)	Codo, Maranhão State, and Ipubi, Pernambuco State (two mines)	100.
Do.	Companhia de Cimento Portland Paraíso (private, 100%)	Ipubi, Pernambuco State (mine)	50.
Kaolin	Caulim da Amazônia S.A. (CADAM) (private, 100%)	Mazagão, Amapá State (mine)	720 (ore).
Do.	do.	Mazagão, Amapá State (beneficiation plant)	360 (concentrate).
Do.	do.	Adam Mine, Rio Jari, Amazonas State	660 (concentrate).
Do.	Pará Pigmentos S.A. (PPSA) (private, 100%)	Pará Mine, Pará State	500 (concentrate).
Do.	Ymerys Rio Capim Caulim S.A. (RCCSA) (private, 100%)	Rio Capim Mine, Pará State	500 (concentrate).
Do.	Empresa de Mineração Horii Ltda. (EMHL) (private, 100%)	Biritiba and Mogi das Cruzes, São Paulo State (two mines)	200 (ore).
Do.	do.	Biritiba and Mogi das Cruzes, São Paulo State (two beneficiation plants)	180 (concentrate).
Limestone	Companhia de Cimento Portland Paraíso (CCPP) (private, 100%)	States of Goiás, Minas Gerais, and Rio de Janeiro (five mines)	2,000.
Do.	Companhia de Cimento Portland Rio Branco (CCPRB, 100%)	Rio Branco do Sul, Paraná State (three mines)	5,500.
Do.	S.A. Industrias Votorantim (SAIV) (private, 100%)	States of Rio de Janeiro and São Paulo (four mines)	1,000.
Magnesite	Magnesita S.A. (MSA) (private, 100%)	Brumado, Bahia State (one major mine and numerous small mines)	1,000 (ore).
Do.	do.	Brumado, Bahia State (two beneficiation plants)	280 (concentrate).
Phosphate rock	Fertilizantes Serrana S.A. (Bunge International Group, 100%)	Araxá, Minas Gerais State (mine)	5,000.
Do.	Copebras S.A.(Copebras) (Anglo American plc, 100%)	Ouvidor, Goiás State (mine)	4,400.
Do.	Fosfertil S.A. (Grupo Fertifós, 81.54%; Companhia Vale do Rio Doce, 10.96%; public, 7.5%)	Tapira, Minas Gerais State (two mines)	10,500.
Do.	Ultrafertil S.A. (Grupo Fertifós, 81.54%; Companhia Vale do Rio Doce, 10.96%; public, 7.5%)	Araxá, Minas Gerais State (mine)	5,000.
Quartz	Telequartz Exportação S.A. (TESA) (private, 100%)	Cristal, Minas Gerais State (mine)	6.0.
Salt, rock	Frota Oceânica Brasileira S.A. (FOBSA) (private, 100%)	Jacupiranga, São Paulo State (mine)	6,000.
Do.	Dow Química do Nordeste Ltd. (DQNL) (Dow Chemical Co., 100%)	Vera Cruz, Bahia State (mine)	1,000.
Do.	Cia. Nacional de Alcalis S.A. (CNA) (private, 100%)	Alcalis Grupo, Rio Grande do Norte State	1,500.
Do.	Salgema Mineração e Química S.A. (SMQ) (private, 100%)	Salgema, Maceió, Alagoas State (mine)	1,000.

TABLE 2--Continued
BRAZIL: STRUCTURE OF THE MINERAL INDUSTRY IN 2003

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
MINERAL FUELS			
Coal	Carbonífera Circúma S.A. (CCSA) (private, 100%)	Circúma and Sideropolis, Santa Catarina State (two mines)	1,600.
Do.	Companhia Carbonífera Metropolitana S.A. (private, 100%)	Circúma, Sideropolis, and Urussanga, Santa Catarina State (three mines)	1,200.
Do.	Copelmi Mineração Ltda. (COPELMI) (private, 100%)	Arroio dos Ratos, Butia, and Charqueadas, Rio Grande do Sul State (four mines)	4,600.
Do.	Companhia Riograndense de Mineração S.A. (private, 100%)	Circúma and Urussanga, Santa Catarina State (two mines)	2,600.
Petroleum thousand 42-gallon barrels	Petróleo Brasileiro S.A. (Petrobrás) (Government, 81.4%; private, 11.8%; public, 6.8%)	Fields in the States of Alagoas, Amazonas, Bahia, Ceará, Espírito Santo, Rio de Janeiro, Rio Grande do Norte, Pará, Maranhão, and Sergipe (99)	220,000.
Petroleum products	do.	Refineries in the States of Amazonas, Bahia, Ceará, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul, and São Paulo	503,000.
Do.	Refinaria de Petróleo Ipiranga S.A. (private, 100%)	Ipiranga, Rio Grande do Sul	3,400.
Do.	Refinaria de Petróleos de Manguinhos S.A. (private, 100%)	Manquinhos, Rio de Janeiro State	3,650.

TABLE 3
BRAZIL: RESERVES OF MAJOR MINERAL COMMODITIES IN 2003¹

(Thousand metric tons unless otherwise specified)

Commodity	Reserves	World ranking	World percentage
Asbestos, fiber	16,000		NA
Bauxite, ore	2,510,000	3	7.8
Chromite, Cr ₂ O ₃	7,100		0.1
Coal, all types	7,372,000		0.6
Columbium (niobium), pyrochlore, and columbite ore	5,200	1	98.0
Copper, metal content	17,400		1.8
Fluorspar, ore	3,100		1.0
Gold, metal metric tons	2,000		2.0
Graphite, ore	95,000	2	26.0
Gypsum	1,269,000		NA
Iron ore, 60% to 65% Fe content	21,000	5	6.5
Kaolin	4,050,000	3	29.0
Lead, metal content	1,000		0.7
Magnesite	180,000	4	8.2
Manganese, metal content	152,000	4	3.0
Natural gas ² million cubic meters	220,000		0.1
Nickel, metal content	6,000		4.0
Petroleum ² million 42-gallon barrels	11,600		0.9
Phosphate rock	260,000		0.8
Talc and pyrophyllite	156,000	3	17.0
Tantalum	89,000	1	52.0
Tin, metal content	2,500	2	22.0
Titanium, TiO ₂	7,200		0.7
Vermiculite	23,000	3	10.0
Uranium, U ₃ O ₈ metric tons	163,000		NA
Zinc, metal content	5,200		1.2
Zirconium, ore	2,000		2.8

NA Not available.

¹Summário Mineral 2002-2003.

²Petróleo Brasileiro, S.A. annual report 2002-03.